

Fawoo PC-Based NC FWMC-U200 Users Manual

VER 2.00

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Chapter 1.

Introduction

1.1 FAWOO PCNC Overview

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1.3 Model Code Definition

1.4 Specification and Environmental Conditions

1. Introduction

1.1. FAWOO PCNC Overview

FAWOO have been developed to bring the advantages of PC-based control to traditional CNC applications. PCNC is also designed as the open-architecture of PC-based USB type that is installed general PC. **FAWOO** PCNC comprises the system of intelligent motion control that combines all aspects of NC and PC environment for easy-to-use, cost-effective solution. **FAWOO** PCNC achieves saving space, reducing the wiring complexity and development time as compared with traditional CNC system.

The features of PCNC are as the followings.

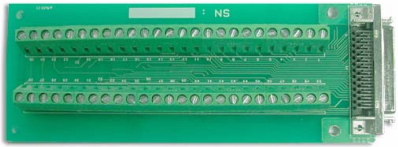
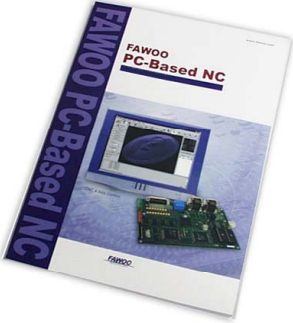
- **Cost effective in motion control application of up to 4 axes:** Motion control of up to 4axes is accomplished under PC environment familiar to most users, which is based on numeric control technology.
- **Simple in connectivity:** A commercially available USB cable is used for communication between PC and the control board that can be placed near your own control box.
- **Quick system setup:** It is tedious to setup a control board in PC motion board slots. Contrast to it, **FAWOO** controller is easy to setup because it can be placed anywhere outside PC.
- **Easy to operate:** The simple operating structure makes **FAWOO** PC-based NC easier to use, even for beginners. It makes you construct a machine system easy to learn.
- **Easy to program a complex motion:** Control system adopted our PC-based NC can be accessed easily by beginners because the program supports versatile file formats such as NC (G-code), PLT, HPGL, DXF as input file formats.
- **Other functions:** Graphic functions such as 3D tool-path, 3D zoom-in and zoom-out enable close examination of the tool-path. Also the block restart function reduces loss time, which might be caused during the invalid machining performed by broken tool.

1.2. Products Configuration

1.2.1. Basic Items

The basic items are provided with Controller as the followings.

- | | |
|----------------------------------|---------------------------------------|
| ① FPMC-U200 Main Controller 1 EA | ② Install S/W for Windows98 CD 1 EA |
| ③ 50pin I/O Terminal Board 2 EA | ④ 50pin I/O Interface Cable 2 EA |
| ⑤ USB Interface Cable(3m) 1 EA | ⑥ FAWOO PCNC Users Manual 1 EA |

	
FPMC-U200	Install CD
	
50Pin I/O Teminal Board	50Pin I/O Interface Cable
	
USB Interface Cable	Users Manual

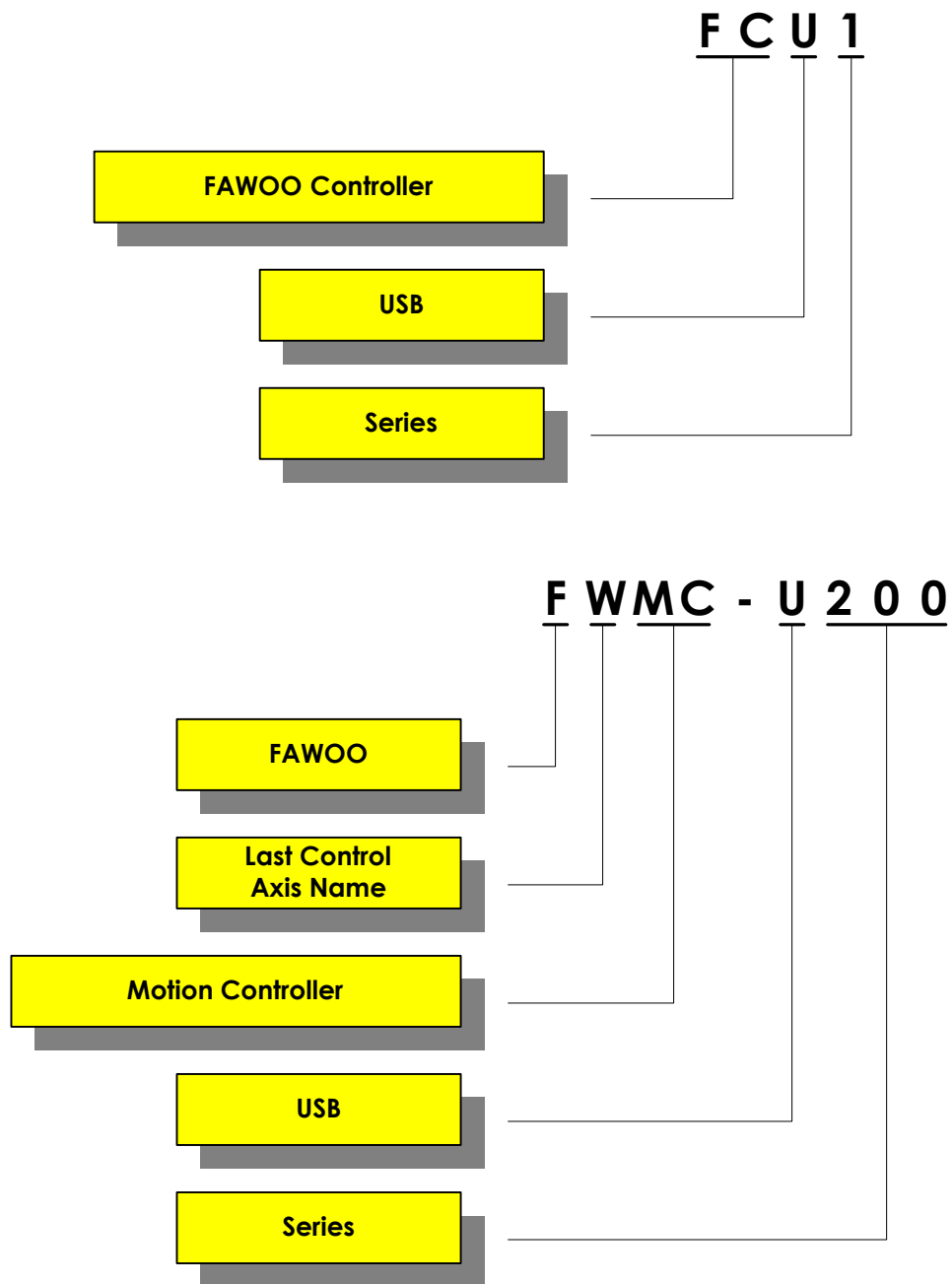
1.2.2. Option Items

Options are purchased separately from that of FWMC-U200 Controller. The following items are not provided when purchasing the Basic items only.

- ① 5V/24V DC Power Supply
- ② FTU: Remote Terminal Unit
- ③ MPG(Manual Pulse Generator)

	
DC Power Supply (SMPS)	FTU : Remote Terminal Unit
	
MPG (Manual Pulse Generator)	

1.3. Model Code Definition



1.4. Specification and Environmental Conditions

1.4.1. General Specification

Items		Specification
PC Communication		USB (Universal Serial Bus) Port
Control Axis		4-Axis(Simultaneously controlled 3-Axis)
Input Voltage		DC 5V ($\pm 5\%$) 1.2A
		DC 24V ($\pm 10\%$) 0.3A
Pulse Train (Servo and step driver interface)		Forward Reverse PP: Four high pulses followed by a low level. NP: Four high pulses followed by a low level.
I/O	Input	32 Point (included 8 limits)
	Output	16 Point
Cable	I/O	0.7m / 1.0m 50Pin
	USB	3m
PC	O/S	Windows 95/98
	CPU	Pentium2 ~
	RAM	64Mbyte ~

1.4.2. Environmental Conditions

Environment	Conditions
Ambient Temperature	0℃ ~ +50℃ (non-freezing)
Ambient Humidity	20% ~90%RH (non-condensing)
Storage Temperature	-20℃ ~ +65℃ (non-freezing)
Storage Humidity	90%RH or less (non-condensing)

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Chapter 2.

Installation and Wiring

2.1 Installation Guidelines

2.2 PCNC System Configuration

2.3 Installation Procedure

2.4 Power Supply

2.5 I/O Signals

2.6 Establishing Connection to PC

2.7 Connecting Servo Drive

2.8 Installation FTU (Optional)

2.9 Installation MPG (Optional)

2. Installation and Wiring

2.1. Installation Guidelines

This chapter describes how to begin the installation of the PCNC controller. **FAWOO** controller and software have been designed to provide simplified easy CNC to the user. This PCNC controller is available in the application fields such as Engraving machine, simplified milling machine and Laser cutting machine. If you want to install another application, contact our company or the sales agent where you bought the product.

2.1.1. Inspection upon Product arrival

When the product arrives, check the following item.

- A. Does the product agree with what you ordered?
- B. Is there any damage during transportation?
- C. Check the drive type and I/O when purchasing the servo and the motor.

If there is any problem, contact immediately the sales division our company or the sales agent where you bought the product.

2.1.2. Controller Mounting

The FWMC is a base-mounting type controller. When installing the controller on the lack of the panel, install the cooling fan in consideration to the mechanical state of the surrounding area so that the controller can operate within the allowable temperature limit (55°C). When FWMC is subject to vibration, remove the vibration using the damping material. Corrosive gas may cause NFB and the wiring terminal to be corroded, which might lead to an accident. In particular, do not install the controller in a hot, humid or dusty place or in a place where a ferrous material or explosive gas exists. If there exists much water or grease, take necessary measures such as attaching a cover. FWMC uses cooling by natural convection, so a sufficient space should be secured around the controller. For wiring distance, make installation near PC and Wire the USB cable as short as possible. USB cable is around 5m in maximum.

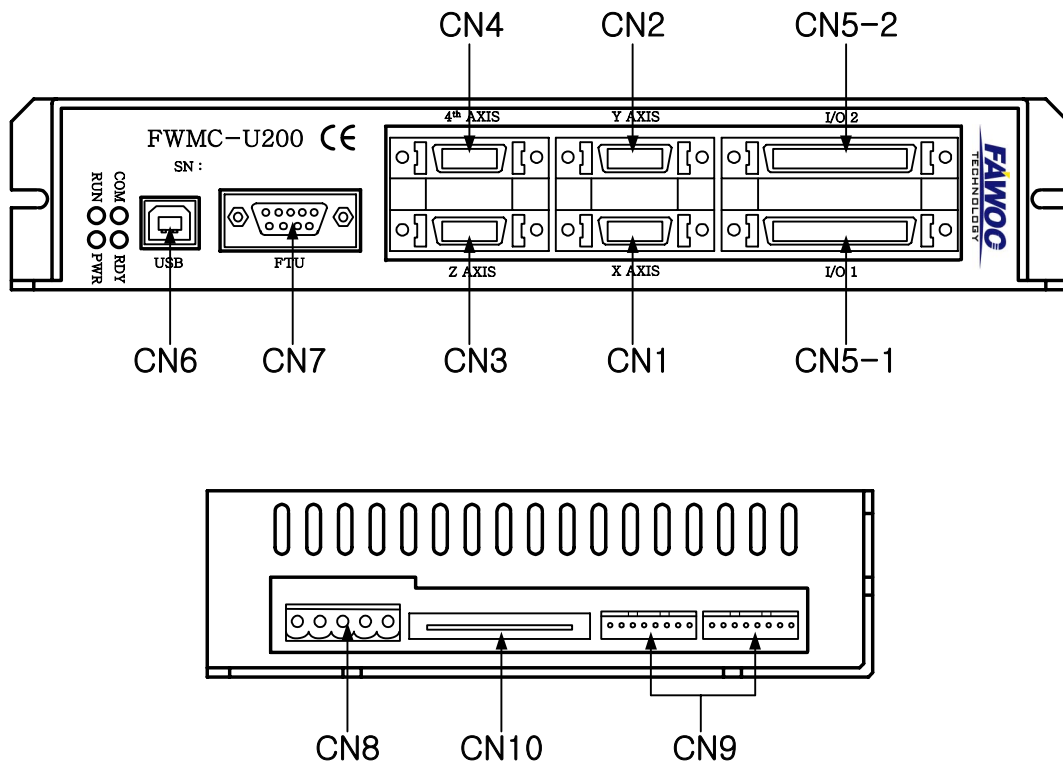
2.1.3. Environment for Installation

The PC and FWMC should be installed indoors, free from corrosive or explosive gas.

- Ambient Temperature: 0 ~ +55°C
- Storage Temperature: -20 ~ +65°C
- Humidity: 20 ~ 90 % (No Condensation) / Vibration 0.5 G (4.9 m/s²)
- Well-ventilated place free of dust of humidity
- Places easily accessible for inspection and cleaning

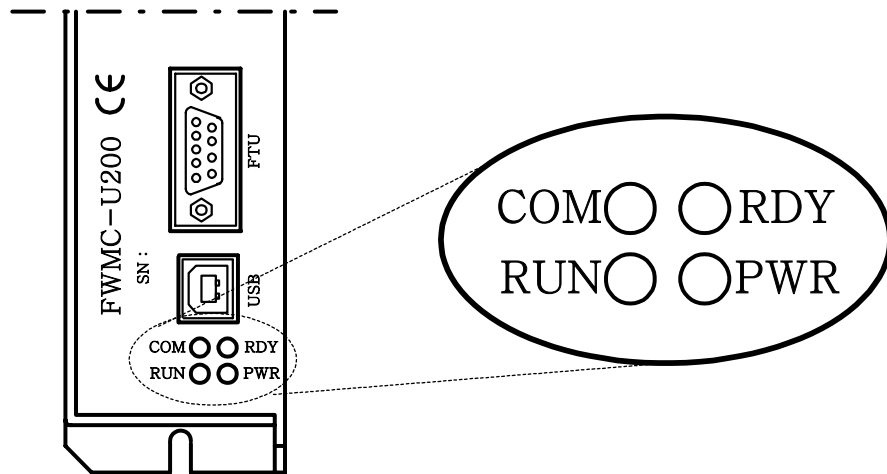


2.1.5. FPMC-U200 Connectors



Symbol	Connector Name	Description
CN1	X	20pin connector connected to X Axis servo drive
CN2	Y	20pin connector connected to Y Axis servo drive
CN3	Z	20pin connector connected to Z Axis servo drive
CN4	4 th	20pin connector connected to 4 TH (W or Q) Axis servo
CN5-1	I/O 1	50pin connector connected to I/O Terminal board #1
CN5-2	I/O 2	50pin connector connected to I/O Terminal board #2
CN6	USB	USB Port connected to PC USB port
CN7	FTU	RS-232C Port to FTU (Remote Terminal) (optional)
CN8	Power	DC 24V, 5V Power is connected to this terminal
CN9	LCD	Connector connected to LCD (optional)
CN10	Keypad	Film Connector connected to Keypad (optional)

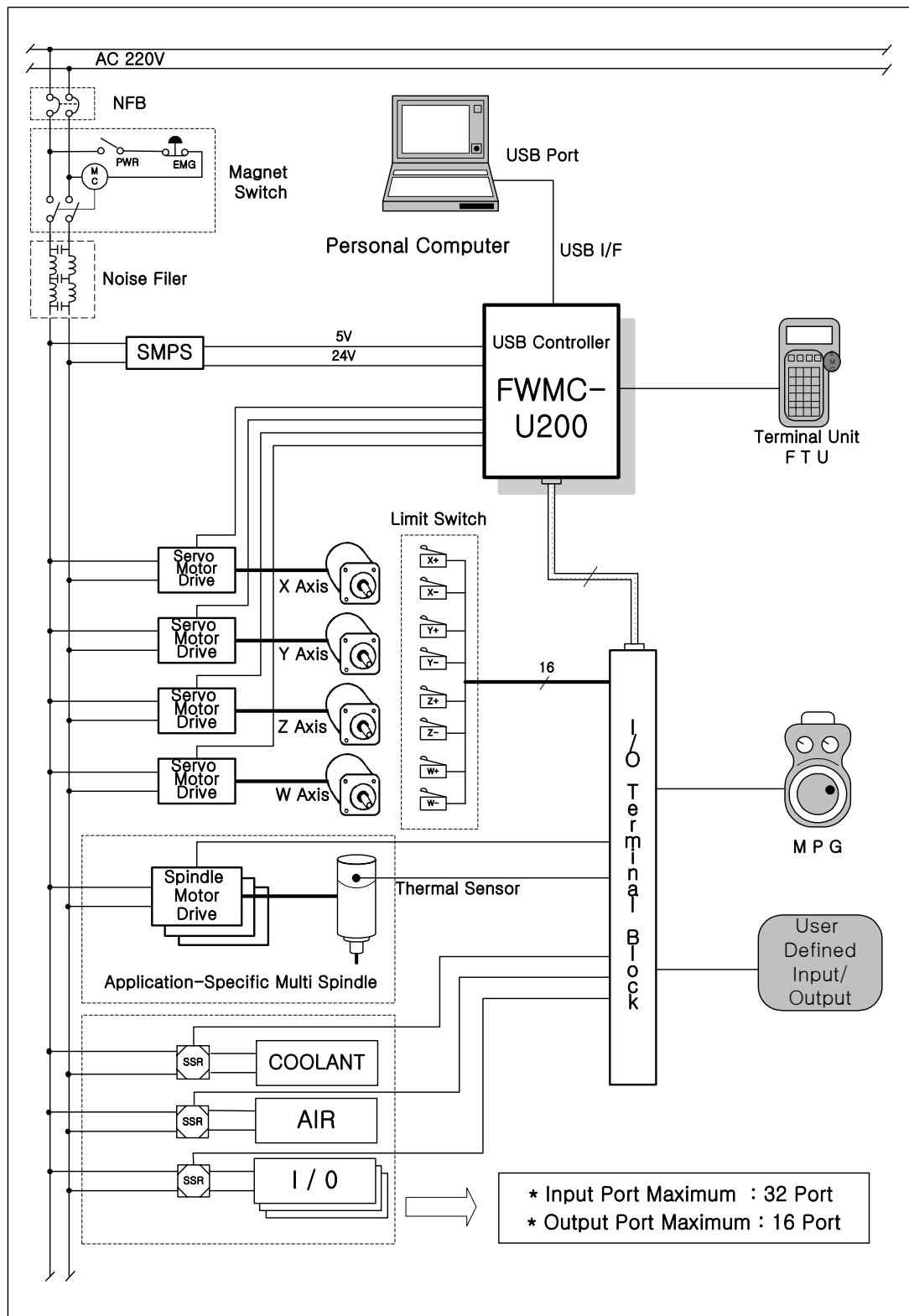
2.1.6. FWMC-U200 LED Description



Symbol	Description
PWR (Green)	This LED turns on when the FWMC power (24V) is on, and turns off when the power (24V) is off.
RDY (Yellow)	This LED turns on when a system error occurs, and be flicked in waiting for USB communication. And turns off when the error is cleared.
COM (Red)	This LED is flicked in normal operation. And turns off when system is abnormal status.
RUN (Green)	This LED is flicked in normal operation. And turns off when system is abnormal status.

2.2. PCNC System Configuration

The following is typical system overview.



2.3. Installation Procedure

The following set up steps are the basic steps required to install FWMC, PC, appropriate cables and connectors and approved power supply, Motor& Driver.

The purpose of this overview is to establish the sequence of events, refer to the next sections for more details.



Do not install motors in the system until the following steps have been completed. Operation of a motor with improper tuning parameters may cause personal injury and equipment damage.

Step1: Connect Power Supply (CN8)

- Prior to connecting power please refer to the Power Supply section for proper power supply selection, cabling and wiring information.
- Connect 5V, 24V, FG to the power connector on the FWMC
- Once Power Supply is connected and installed then you can check FWMC by PWR LED (green). If the system is normal condition, RDY LED (green) is flashed.

Note: To ensure wiring is done correctly and set up of the FWMC is proper do not connect the AC Power until verification and set up is confirmed.

Step2: I/O Connection (CN5-1, CN5-2)

- System reviewing and defining inputs, outputs to the FWMC unit.
- Connect input and Output signals as described in detail in I/O Connection section.
- Manually check all of the inputs and outputs to ensure proper wiring and operation.
- If there were any unexpected errors at any time please refer to the appropriate Trouble Shooting on chapter 6.

Step3: Connect to PC (CN6)

- Please refer to the section Connecting to a Host Computer before connecting to the communication port.
- Install the **FAWOO** PCNC program on PC. (CD supplied by **FAWOO**).
- Connect the USB cable.
- Test communications and set the mode of operation through Software.

Step4: Connect Servo Drive (CN1~CN4)

- Please refer to users Manual of Servo Driver & Motor and connection specification.
- Disconnect all power the FWMC unit
- Wire a connection for servo drive to FWMC unit
- Don't connect the connector when the power supply is on.
- Reapplying power, system & communications will need to be reset
- Verify that servo drive are wired correctly through manual moving and position monitoring in PC.

2.4. Power Supply

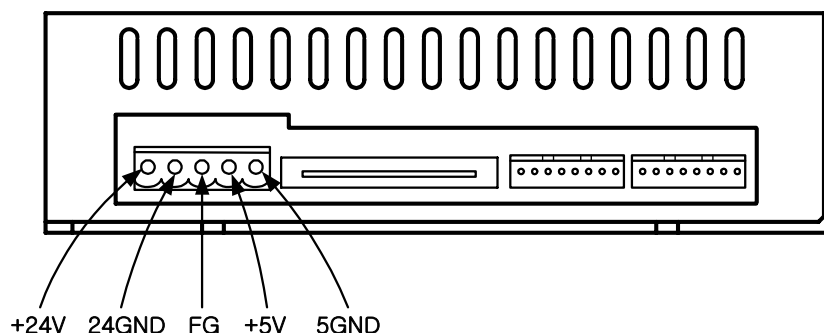
In order to provide adequate power to the FWMC, your power supplies should meet the specifications provided below. The power supply can be purchased from **FAWOO**. The provided power on the FWMC will then supply power to I/O, FTU and Option items.

- Select a suitable power supply for your System
- Wire a power supply to FWMC CN8
- Ground a system properly

Power Supply Requirements

Item	24V	5V
Voltage	+24V $\pm$ 10%	+5V $\pm$ 5%
Current	1.5 A	3 A
Rise Time	100 mS Max	100 mS Max
Protection Circuit	Over Voltage Protection	Over Voltage Protection
	Over Current Protection	Over Current Protection

Show the pin-out for the power supply connector below, The Power connector that is recommended for use with the FWMC is a 5pin Phoenix.



Please follow all safety precaution for power supply connection such as providing proper equipment grounding, correctly fused power, and an Emergency Stop circuit which can immediately rover power in the case of a malfunction. For your protection, please ensure that the FWMC is ground by a conductor sufficient to carry the maximum current your system is using in case of an electrical malfunction occurs. It is recommended to install the noise filter for the power input. Attach the surge absorber to the relay, molded case circuit breaker (MCCB) and magnetic contactor.

2.5. I/O Signals

2.5.1. I/O Connections (CN5-1, CN5-2)

The I/O wiring should be made referring to the connector specification, the cable specification and the wiring diagram.

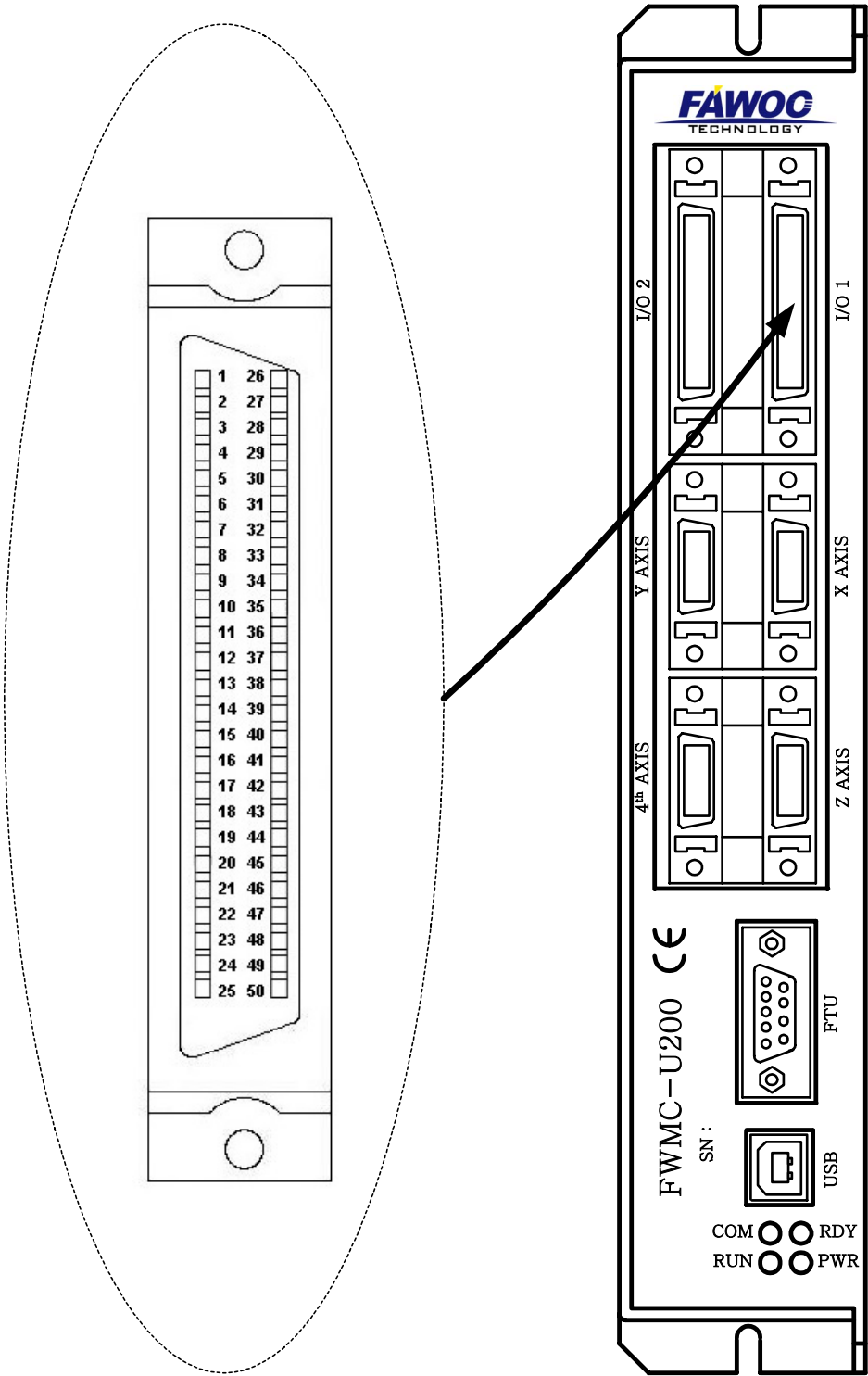
- Create an interface diagram
- Select which I/O to connect
- Define dedicated Inputs for four axes limit & break signal
- Wire, connect and ground

The user I/O is provided for all four axes in one 50-pin connector on the FWMC unit. **FAWOO** provided 50pin I/O cable is bi-directional cable. You can connect to any side on FWMC and I/O terminal board.

Note: You must terminate not using axis limits to +24V(B type Switched), otherwise error occur and error message display.

In general, there are 32 opto-isolated inputs include 8 limits and 16 opto-isolated outputs. I/O has been designed to scale from simple PCNC application requiring only a few I/O. And PCNC doesn't support PLC (Programmable Logic Control) function. So each I/O be used only recommended I/O specification Table below. If you want to control I/O then you can control simple I/O by NC M code programming and refer to the NC programming chapter 7. Generally all wiring to this connector should be made using Wire gauge: #18 to #26 AWG stranded insulated and shielded wire. The pin out for these general I/O lines is illustrated below.

I/O 1 Specifications



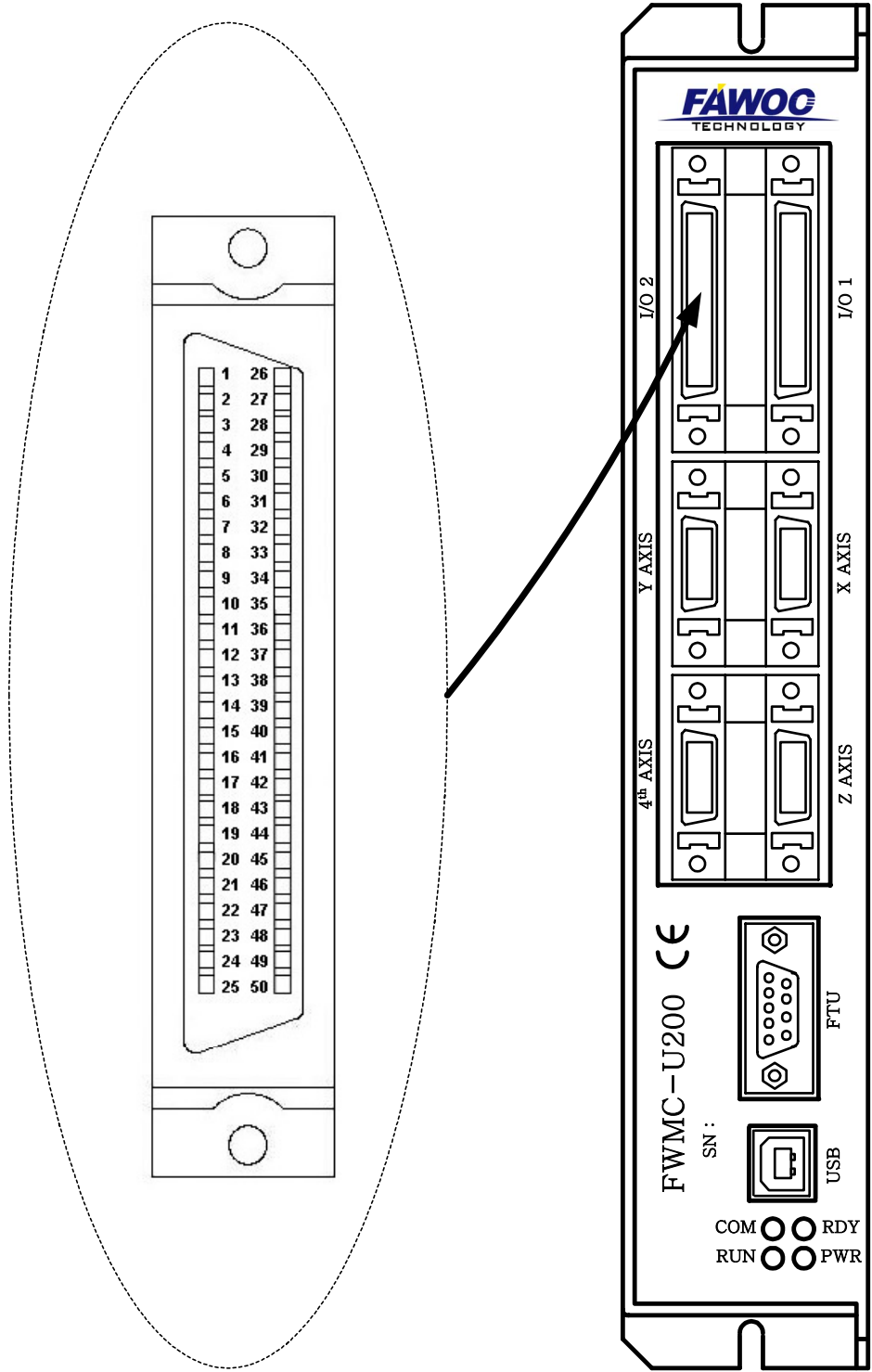
I/O 1 Descriptions

No	Name	Description	Remark
1-1	+24V	+24V, VDD	Not using these pins, you must terminate to +24V (B type Switched). When the origin is performed, 3 limits (XL-,YL-,ZL+) is used.
1-2	XL+	X Axis Forward limit Input	
1-3	XL-	X Axis Reverse limit Input	
1-4	+24V	+24V, VDD	
1-5	YL+	Y Axis Forward limit Input	
1-6	YL-	Y Axis Reverse limit Input	
1-7	+24V	+24V, VDD	
1-8	ZL+	Z Axis Forward limit Input	
1-9	ZL-	Z Axis Reverse limit Input	
1-10	+24V	+24V, VDD	
1-11	WL+	W Axis Forward limit Input	
1-12	WL-	W Axis Reverse limit Input	
1-13	NC	No Connection	No Connection
1-14	+24V	+24V, VDD	User defined output (You can output by M code on NC programming)
1-15	/OUTPUT7	OUTPUT7	
1-16	/OUTPUT6	OUTPUT6	
1-17	/OUTPUT5	OUTPUT5	
1-18	/OUTPUT4	OUTPUT4	
1-19	/OUTPUT3	OUTPUT3	
1-20	/OUTPUT2	OUTPUT2	
1-21	/OUTPUT1	OUTPUT1	
1-22	/OUTPUT0	OUTPUT0	
1-23	+24V	+24V, VDD	
1-24	/OUTPUT0_E	OUTPUT0 Emitter Output	OUTPUT0 Independent Output
1-25	/OUTPUT0_C	OUTPUT0 Collector Output	

2. Installation and Wiring

No	Name	Description	Remark
1-26	+5V	+5V, VCC	MPG Interface
1-27	5GND	5V GND	
1-28	HA	MPG Pulse Train	
1-29	/HA	MPG Pulse Train	
1-30	HB	MPG Pulse Train	
1-31	/HB	MPG Pulse Train	
1-32	/MPG0	Axis Select	
1-33	/MPG1		
1-34	/MPG2	Multiply	
1-35	/MPG3		
1-36	+24V	+24V, VDD	
1-37	24GND	24V GND	
1-38	/R_IN0	Reserved Input0	Reserved
1-39	/R_IN1	Reserved Input1	
1-40	24GND	24V GND	
1-41	BRK_Z	Z Axis Brake Output	+24V Brake Output
1-42	BRK_W	W(4 th) Axis Brake Output	
1-43	24GND	24V GND	
1-44	/R_IN2	Reserved Input2	Reserved
1-45	/R_IN3	Reserved Input3	
1-46	24GND	24V GND	
1-47	NC	No Connection	No Connection
1-48	NC	No Connection	
1-49	NC	No Connection	
1-50	NC	No Connection	

I/O 2 Specifications



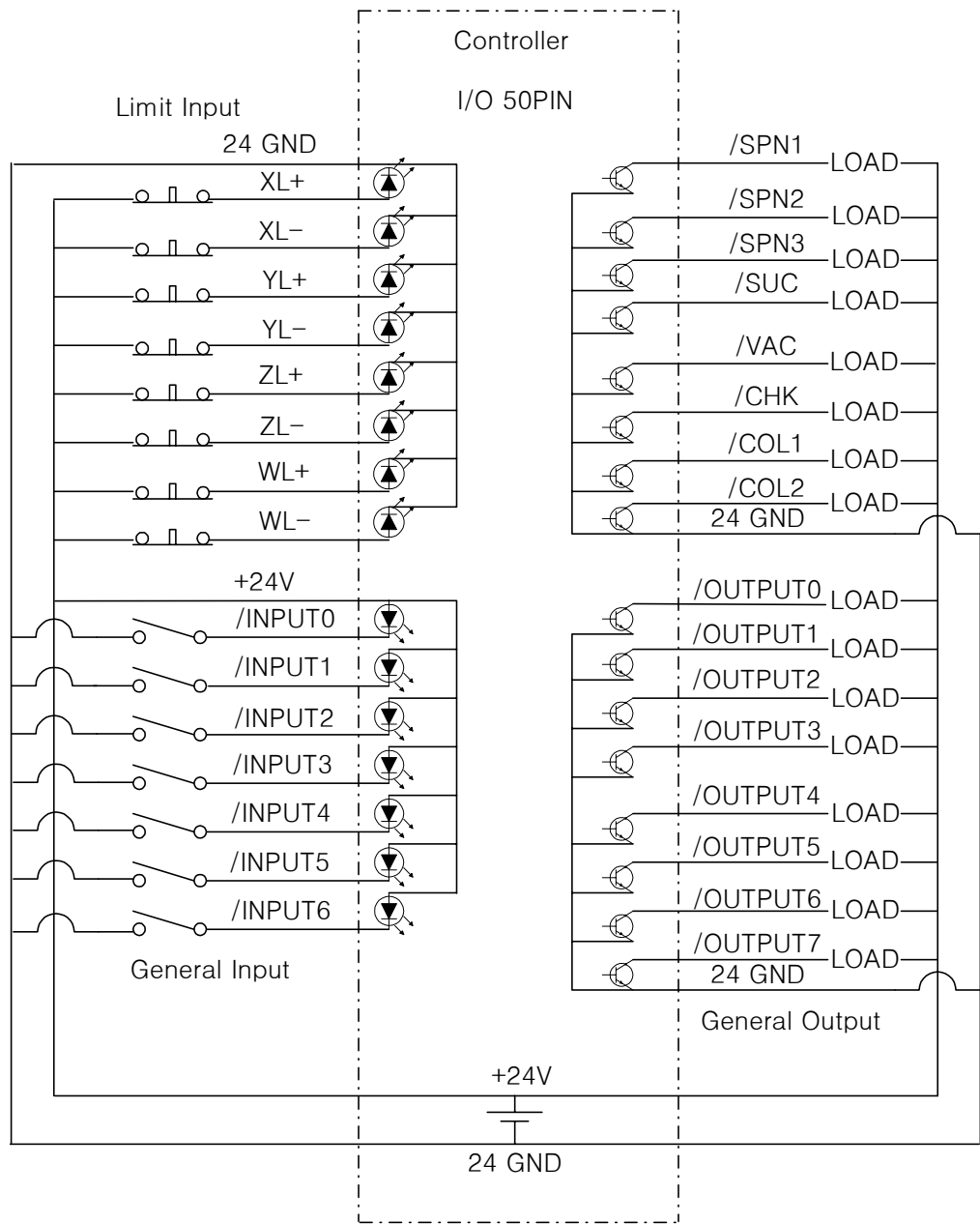
I/O 2 Descriptions

No	Name	Description	Remark
2-1	/INPUT0	INPUT0	User defined Inputs (You can using input by NC programming)
2-2	/INPUT1	INPUT1	
2-3	/INPUT2	INPUT2	
2-4	/INPUT3	INPUT3	
2-5	24GND	24V GND	
2-6	/INPUT4	INPUT4	
2-7	/INPUT5	INPUT5	
2-8	/INPUT6	INPUT6	
2-9	/INPUT7	INPUT7	
2-10	24GND	24V GND	
2-11	/INPUT8	INPUT8	
2-12	/INPUT9	INPUT9	
2-13	/INPUT10	INPUT10	
2-14	/STR_IN	Start Command Input	Pre defined operation input
2-15	24GND	24V GND	
2-16	/STP_IN	Stop Command Input	
2-17	/PAU_IN	Pause Command Input	
2-18	/ORG_IN	Origin Command Input	
2-19	/E_IN	Emergency Input	
2-20	24GND	24V GND	
2-21	+24V	+24V, VDD	24V Power Output
2-22	NC	No Connection	No Connection
2-23	NC	No Connection	
2-24	NC	No Connection	
2-25	NC	No Connection	

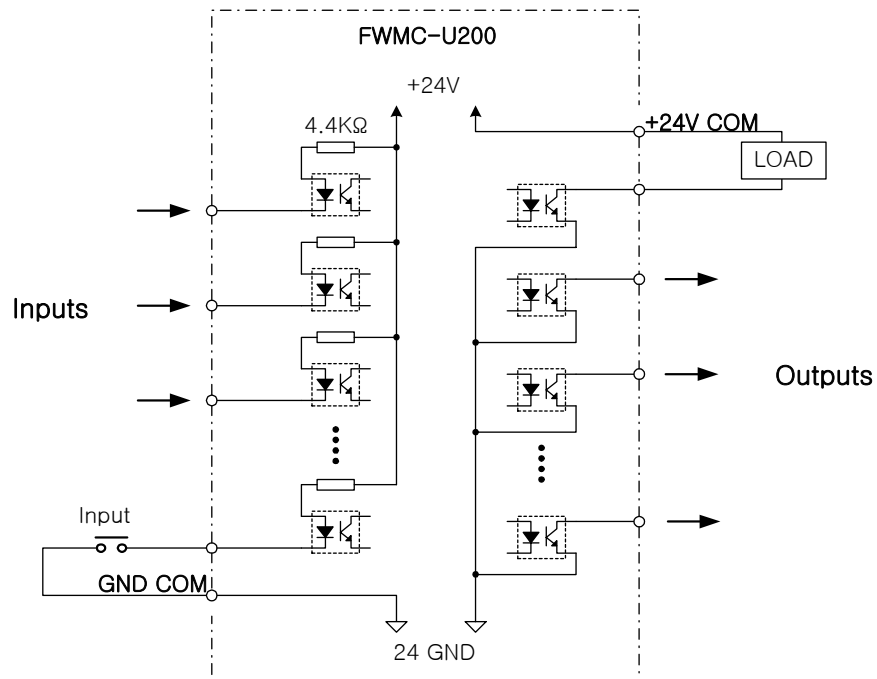
No	Name	Description	Remark
2-26	+5V	+5V, VCC	5V Power Output
2-27	5GND	5V Ground	
2-28	NC	No Connection	No Connection
2-29	NC	No Connection	
2-30	NC	No Connection	
2-31	NC	No Connection	
2-32	NC	No Connection	
2-33	NC	No Connection	
2-34	NC	No Connection	
2-35	NC	No Connection	
2-36	NC	No Connection	
2-37	NC	No Connection	
2-38	24GND	24V Ground	24V Power Output
2-39	+24V	+24V, VDD	
2-40	24GND	24V Ground	
2-41	+24V	+24V, VDD	Outputs
2-42	/OUTPUT8	OUTPUT8	
2-43	/OUTPUT9	OUTPUT9	
2-44	/OUTPUT10	OUTPUT10	
2-45	/RUN_OUT	Run Signal Output	Statue Outputs
2-46	+24V	+24V, VDD	
2-47	/ERR_OUT	Error Signal Output	
2-48	/PAU_OUT	Pause Signal Output	
2-49	/ORG_OUT	Origin end Signal Output	
2-50	/E_OUT	Emergency Output	

2.5.2. I/O Interface (CN5-1,CN5-2)

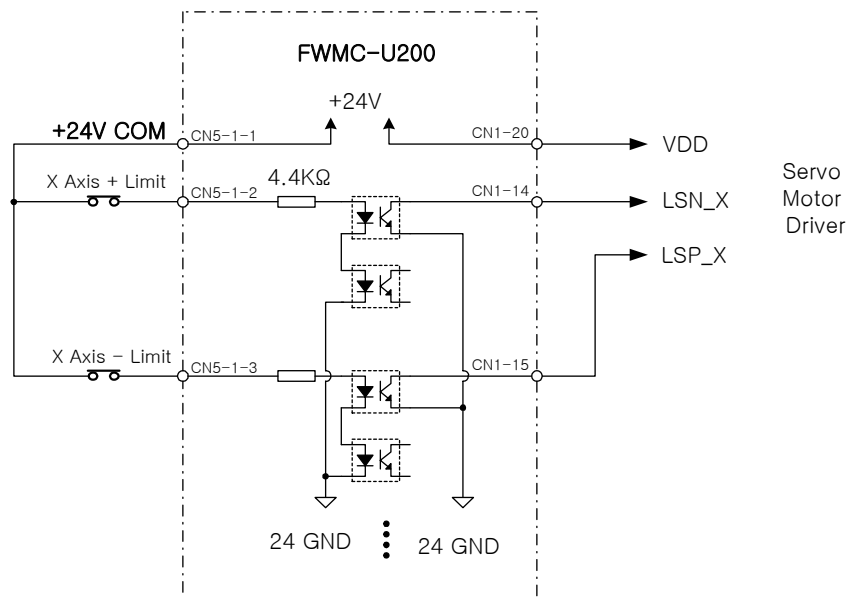
The following series of schematics represent reference for the configuration of the FWMC.



Input / Output Internal Circuit of FPMC-U200



Limit Circuit of FPMC-U200 (X Axis)



2.6. Establishing Connection to PC

Upon completion of this section user will be able to:

- ① Before connecting the PCNC controller with the personnel computer for the first time, you should make sure of the FCUI's normal acting. You can make sure it through the signal of PWR LED on the FWMC board.
- ② The PWR LED indicates the power supply generates +24V. When the power supply provided +24V to the controller, this signal is always turned on.
- ③ The RDY LED indicates the power supply generates +5V. You can also make sure of a normal communication link between PC and the controller through this signal. Before a normal communication, this signal is flickered. It means that the controller waits the communication with the PC.
- ④ Connect the connector (CN6) on the FWMC with the USB port on the PC using USB cable. (The connector is inscribed with 'USB')
- ⑤ When the PC and the controller are turned on, you can connect the USB cable between them. It does no harm on the PC or the controller. You can connect the USB cable between them, whether they turned on or not.
- ⑥ When connecting the controller with the PC for the first time, windows (PC's operating system) detect the controller automatically, and require to installing the file for drivers. This file is included in the CD. (Please refer to the Chapter 3 – Installing Software)
- ⑦ After normal connecting the PC with the controller through USB cable, the RDY LED is turn off and then the COM LED starts on being flickered. It means that the connection is completed.
- ⑧ Don't remove the USB cable from the PC or the controller under machining process, or the communication between them is cut off and then the servo motor is stopped. (If you connect the UCB cable between them, the machining process goes on.)
- ⑨ In case you want to connect or remove the cable under the machining process,
 - Press the 'stop' button, and then the machining process is stopped.
 - Connect or remove the cable between them.

Note: When connecting the USB port of your PC to USB port of the FWMC, verify that your PC's ground is the same as the FWMC ground. Failure to do so can result in damage to your PC and/or FWMC.

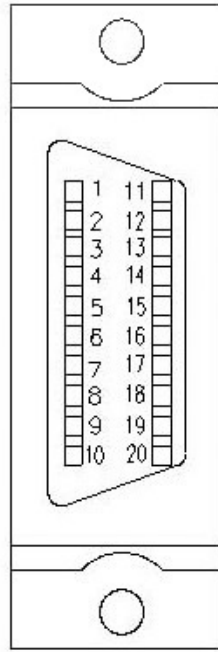
2.7. Connecting Servo Drive

2.7.1. Procedures of Connection

This section describes the fast and easy installation of the PCNC controller for the servo drive familiar to users. Users who are not familiar to the wiring or the connection must refer to the users manual of suitable servo driver & motor and the connection specification. The servo driver cable processes the pulse commands and the alarm signals, so it should be wired with the twisted wire or multi-core twisted pair shielded wire. The cable thickness should not be less than AWG28. And the maximum length of the cable is 1.5M.

- Install the PCNC program in PC.
- Disconnect all power from the FWMC unit.
- Check whether all servo drives are turned off.
- Wire the connection for servo drive to FWMC unit.
- Execute the PCNC program in PC.
- Set system parameters on the System Parameters dialog box.
- To set and check the pulse output mode and related parameters of servo drives.
- Don't connect the cables to the connector when the power supply is on. Always connect the cable to the connector after applying the power. Otherwise the FWMC unit may be damaged.
- Verify that servo drives are wired correctly with the manual moving and the position monitoring in PC.
- Check in the PCNC program whether the actual position values change. If the values are not corrected, there are problems in the installation for the PCNC program and servo drives.

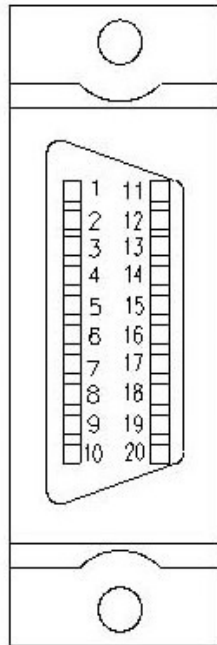
2.7.2. Specifications

CN1: X-axis

PIN	Signal Name	PIN	Signal Name
1	-	11	-
2	ALM_X	12	SG
3	-	13	-
4	-	14	LSN_X
5	SG	15	LSP_X
6	-	16	-
7	NG_X-	17	LG
8	NP_X-	18	-
9	PG_X+	19	FG
10	PP_X+	20	VDD

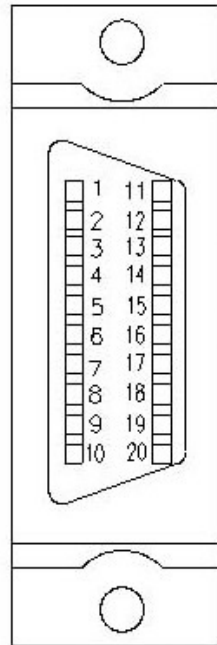
No	Name	Description
2	ALM_X	X-axis Servo Alarm
5, 12	SG	Signal Ground, 24V GND
7	NG_X-	X-axis Reverse rotation Negative pulse train
8	NP_X-	X-axis Reverse rotation Positive pulse train
9	PG_X+	X-axis Forward rotation Negative pulse train
10	PP_X+	X-axis Forward rotation Positive pulse train
14	LSN_X	X-axis Reverse rotation stroke end
15	LSP_X	X-axis Forward rotation stroke end
17	LG	Logic Ground, 5V GND
19	FG	Frame Ground
20	VDD	+24V

CN2: Y-axis



PIN	Signal Name	PIN	Signal Name
1	-	11	-
2	ALM_Y	12	SG
3	-	13	-
4	-	14	LSN_Y
5	SG	15	LSP_Y
6	-	16	-
7	NG_Y-	17	LG
8	NP_Y-	18	-
9	PG_Y+	19	FG
10	PP_Y+	20	VDD

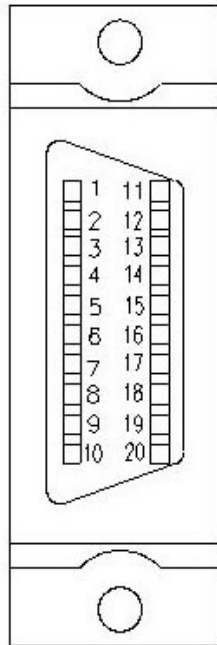
No	Name	Description
2	ALM_Y	Y-axis Servo Alarm
5, 12	SG	Signal Ground, 24V GND
7	NG_Y-	Y-axis Reverse rotation Negative pulse train
8	NP_Y-	Y-axis Reverse rotation Positive pulse train
9	PG_Y+	Y-axis Forward rotation Negative pulse train
10	PP_Y+	Y-axis Forward rotation Positive pulse train
14	LSN_Y	Y-axis Reverse rotation stroke end
15	LSP_Y	Y-axis Forward rotation stroke end
17	LG	Logic Ground, 5V GND
19	FG	Frame Ground
20	VDD	+24V

CN3: Z-axis

PIN	Signal Name	PIN	Signal Name
1	-	11	-
2	ALM_Z	12	SG
3	-	13	-
4	-	14	LSN_Z
5	SG	15	LSP_Z
6	-	16	BK1
7	NG_Z-	17	LG
8	NP_Z-	18	-
9	PG_Z+	19	FG
10	PP_Z+	20	VDD

No	Name	Description
2	ALM_Z	Z-axis Servo Alarm
5, 12	SG	Signal Ground, 24V GND
7	NG_Z-	Z-axis Reverse rotation Negative pulse train
8	NP_Z-	Z-axis Reverse rotation Positive pulse train
9	PG_Z+	Z-axis Forward rotation Negative pulse train
10	PP_Z+	Z-axis Forward rotation Positive pulse train
14	LSN_Z	Z-axis Reverse rotation stroke end
15	LSP_Z	Z-axis Forward rotation stroke end
16	BK1	Z-axis Brake
17	LG	Logic Ground, 5V GND
19	FG	Frame Ground
20	VDD	+24V

CN4: 4th-axis



PIN	Signal Name	PIN	Signal Name
1	-	11	-
2	ALM_W	12	SG
3	-	13	-
4	-	14	LSN_W
5	SG	15	LSP_W
6	-	16	BK2
7	NG_W-	17	LG
8	NP_W-	18	-
9	PG_W+	19	FG
10	PP_W+	20	VDD

No	Name	Description
2	ALM_W	4 th -axis Servo Alarm
5, 12	SG	Signal Ground, 24V GND
7	NG_W-	4 th -axis Reverse rotation Negative pulse train
8	NP_W-	4 th -axis Reverse rotation Positive pulse train
9	PG_W+	4 th -axis Forward rotation Negative pulse train
10	PP_W+	4 th -axis Forward rotation Positive pulse train
14	LSN_W	4 th -axis Reverse rotation stroke end
15	LSP_W	4 th -axis Forward rotation stroke end
16	BK2	4 th -axis Brake
17	LG	Logic Ground, 5V GND
19	FG	Frame Ground
20	VDD	+24V

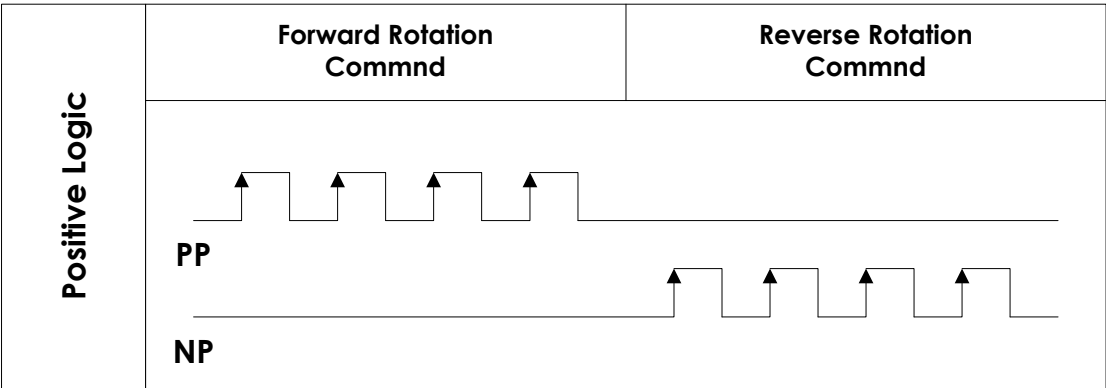
2.7.3. Connection Instructions

Servo-on Signal: FWMC-U200 doesn't send the servo-on signal to the servo drive. So you must set the parameter that make servo-on signal switched on automatically in the servo drive. If the servo drive doesn't offer such function, you must set on the servo-on pin of the servo drive.

Servo Alarm Signal: When a fault occurs during operation, the corresponding alarm is displayed on the servo drive. FWMC-U200 catches the alarm signal from the servo drive for checking the status. If you use stepping motor drivers or servo drivers without the alarm signal, you must set the option parameter to ignore the alarm signal by using PCNC Software. Setting the option parameters is important to the function of FWMC-U200, so it is required the password to change the option parameters. For demanding the password, please contact **FAWOO** or agents.

Rotation Pulse Signal: FWMC-U200 only uses one form of pulse train output. The following figure is the form of pulse train output.

So you must check and set pulse output mode and related parameters of servo drivers.

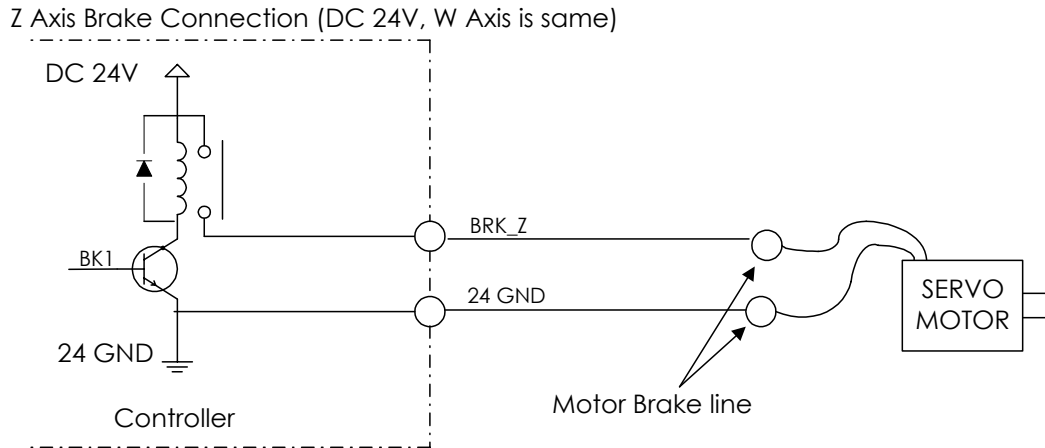


If you change the wiring of PP and NP, you can change the direction of motor. (Also LSN and LSP must be changed.)

Forward/Reverse Rotation Stroke End Signal (LSP/LSN): If a limit signal is on, FWMC-U200 doesn't send the pulse signals to the direction. Also FWMC-U200 send LSP or LSN signal to the servo drive to prevent rotating in the direction. Because FWMC-U200 doesn't send the pulse signals to the direction when a limit signal is on, the motor is stopped without LSN and LSP signals. But you are ensured the safe operation with using LSP and LSN signals. If the motor doesn't rotate in both directions when a limit signal is on, please change the wiring of LSN and LSP signals.

2.7.4. Motor Brake Cable Wiring

Connect the brake cable to the connector pin 1-40 and pin 1-41 of the CN5-1. The internal wire of each pin composed of two strands, and the pin specification and the internal circuit are as shown below. The FPMC controller supports I/O for Z-axis and 4th-axis motor break basically.

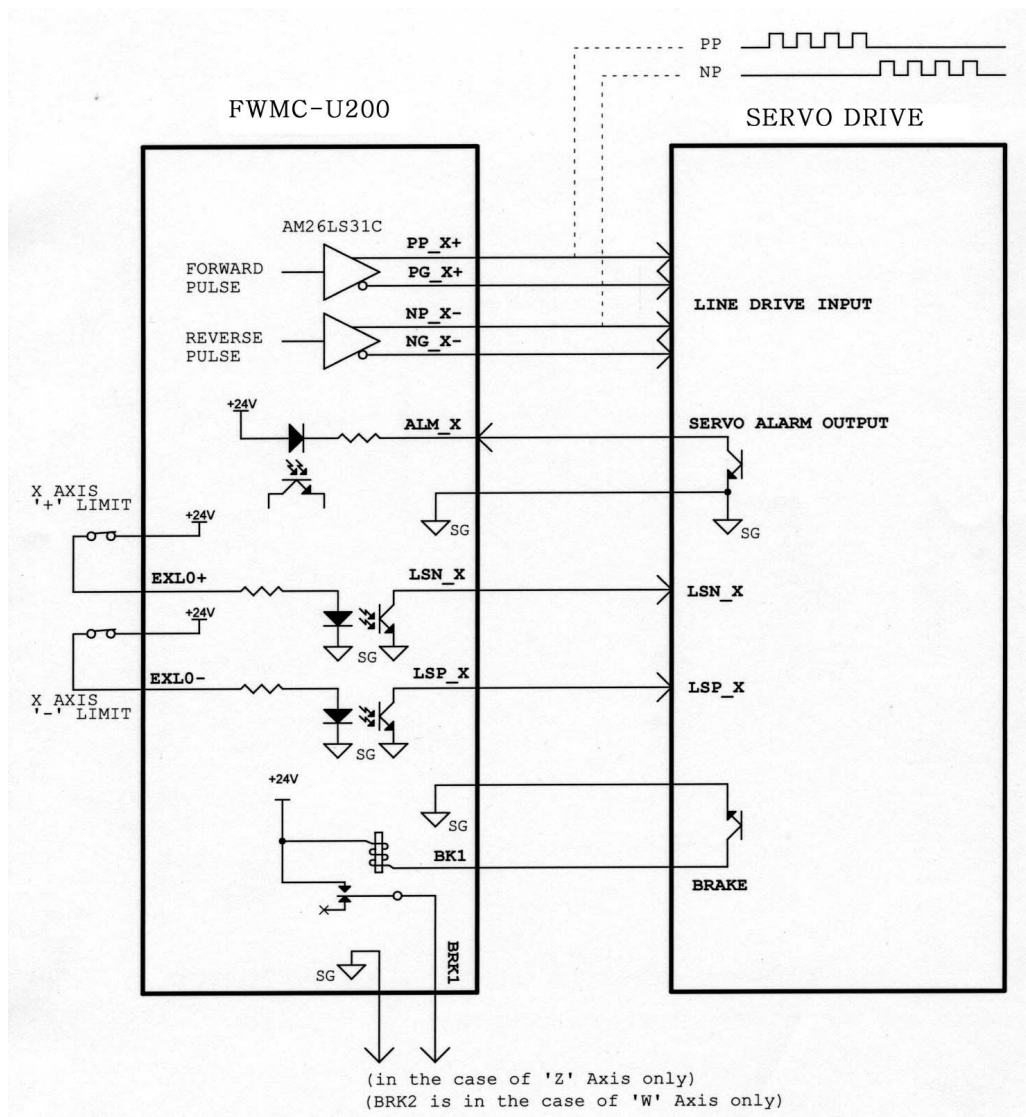


Example 1:

Servo Drive Parameter setting (MISUBISHI SERVO DRIVE MR-J2S-)

Para. No	Name of Function	X-axis Value	Z-axis Value	Remark
1	Function selection1	0000	0010	Other parameters are initial values.
2	Auto tuning	0108	010C	
3	Electronic gear	Any value	Any value	
4	Electronic gear	Any value	Any value	
19	Parameter block	000C	000C	
21	Function selection3	0000	0000	
41	Input signal automatic ON selection	0001	0001	

Typical connection (MISUBISHI SERVO DRIVE MR-J2S-)

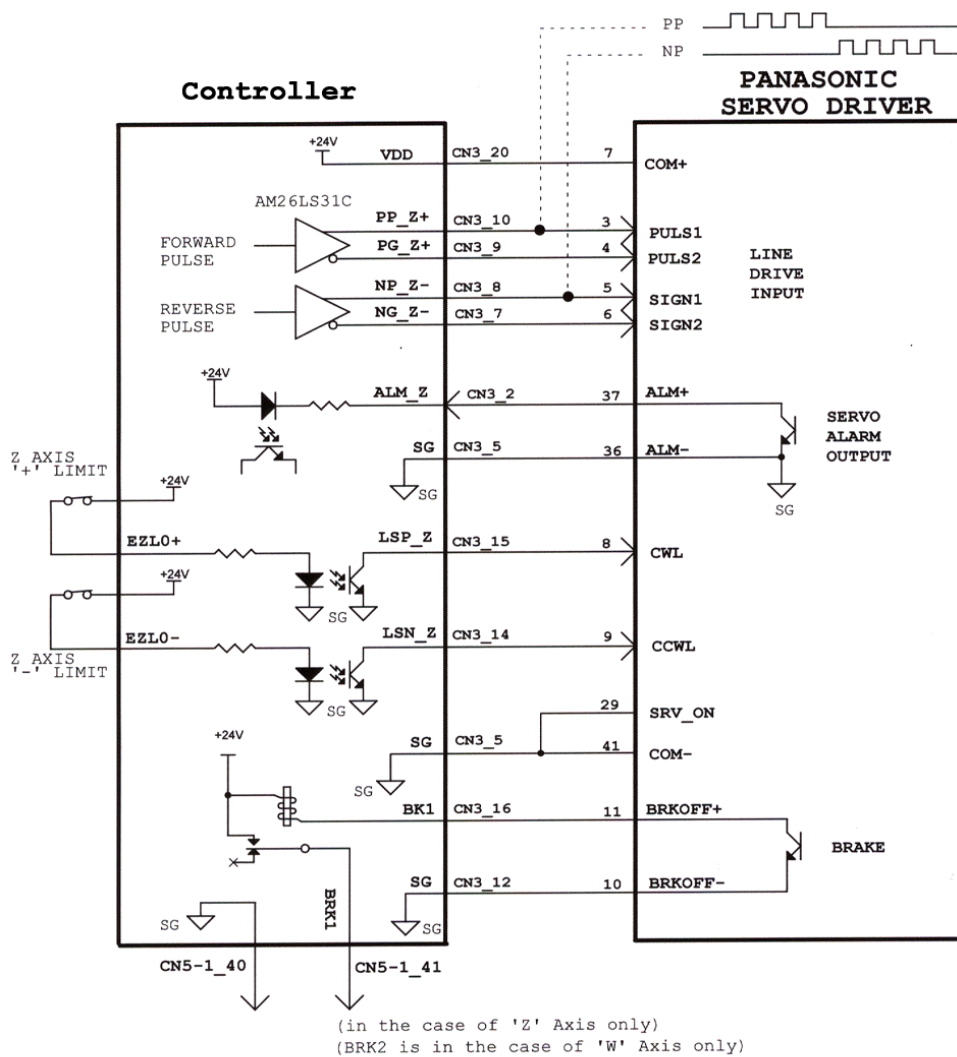


Example 2:

Servo Drive Parameter setting (Panasonic SERVO DRIVE MINAS A- series)

Para. No	Name of Function	X-axis Value	Z-axis Value	Remark
02	Control mode set-up	0	0	Other parameters are initial values.
04	Overtravel input inhibit	0	0	
41	Command pulse logic inversion	0	0	
42	Command pulse input mode set-up	1	1	
43	Command pulse inhibit input invalidation	1	1	
46	Electronic gear	Any value	Any value	
4B	Electronic gear	Any value	Any value	

Typical connection (Panasonic SERVO DRIVE MINAS A- series)



2.8. Installation FTU: Remote Terminal (Optional)

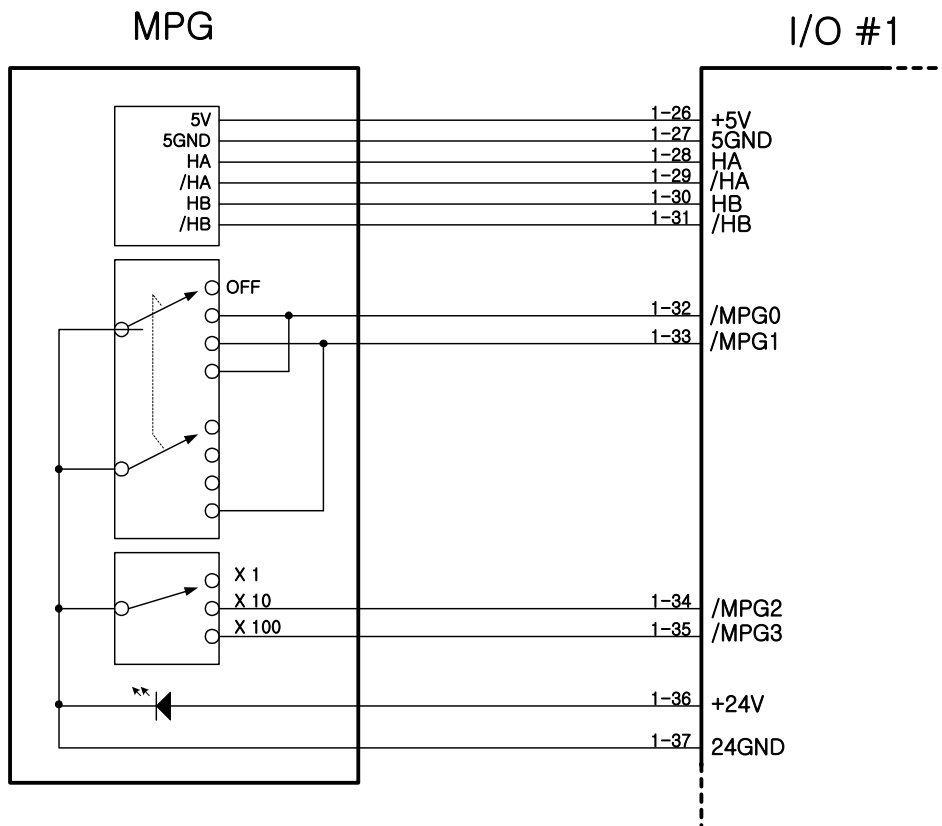
The RS232 communication can be made with the FTU through connector CN7 on the FWMC. Please refer to the chapter 5 (Remote Terminal) and test the unit once whether the wiring is complete. Don't connect the cable to the connector when the power is on. Always connect the cable to the connector and then apply the power. Otherwise, the FWMC unit may be damaged.

Item	Description
Baud rate	9600 bps Asynchronous system
Frame bit	8 Bit
Parity check	No parity
Stop bit	1

2.9. Installation MPG: Manual Pulse Generator (Optional)

We recommend using the MPG offered from **FAWOO**. The power and signal wires are connected to I/O 1 terminal board.

- Power off of FPMC-U200.
- Connect the power cable and signal cable with the I/O 1 terminal board.
- Always operation LED is on, if FPMC-U200 is power on.



MEMO

Chapter 3.

Installing Software

3.1 System Requirements

3.2 Installing PCNC Software

3.3 Uninstalling PCNC Software

3.4 Adding Device Driver

3. Installing Software

This chapter describes how to begin the installation of the PCNC software. Before beginning the install, ensure that your system meets the requirements described in the “System Requirements” section.

3.1. System Requirements

PC Basics

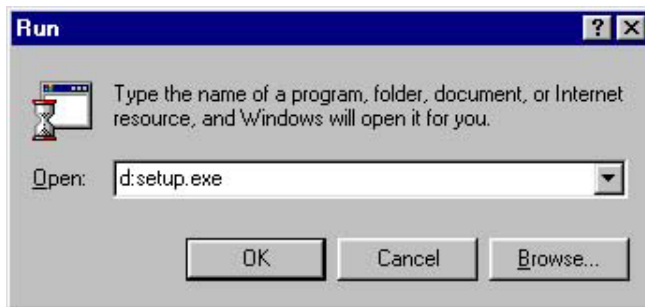
The following list specifies the type of PC you should have to use our PCNC software.

- IBM PC or compatible PC with a Pentium Processor, 300 MHz clock speed
- System memory (RAM) - 64 MB, 128MB recommended.
- Windows 95 or Windows 98
- 2GB disk space recommended.
- SVGA 17inch monitor
- Keyboard
- Mouse - 2-button or 3-button (Microsoft Windows compatible).
- CD-ROM drive
- USB port for the USB communication.
- LAN card (Optional)

3.2. Installing PCNC Software

This section describes how to start your PCNC software installation.

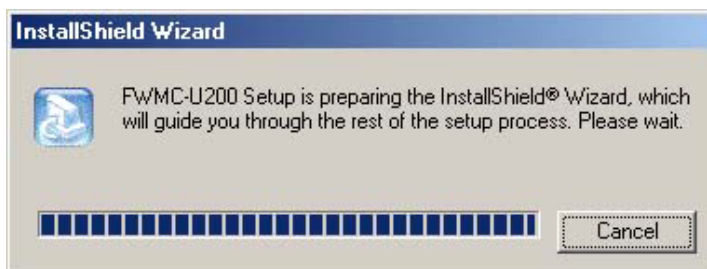
- Close all programs.
- To start the installation, insert the PCNC software CD into the CD-ROM drive.
- Select **Start** → **Run**. Type *d:\setup.exe* in the Open field of the Run window. (If your CD-ROM drive is not “d” drive, substitute the appropriate drive designation.)



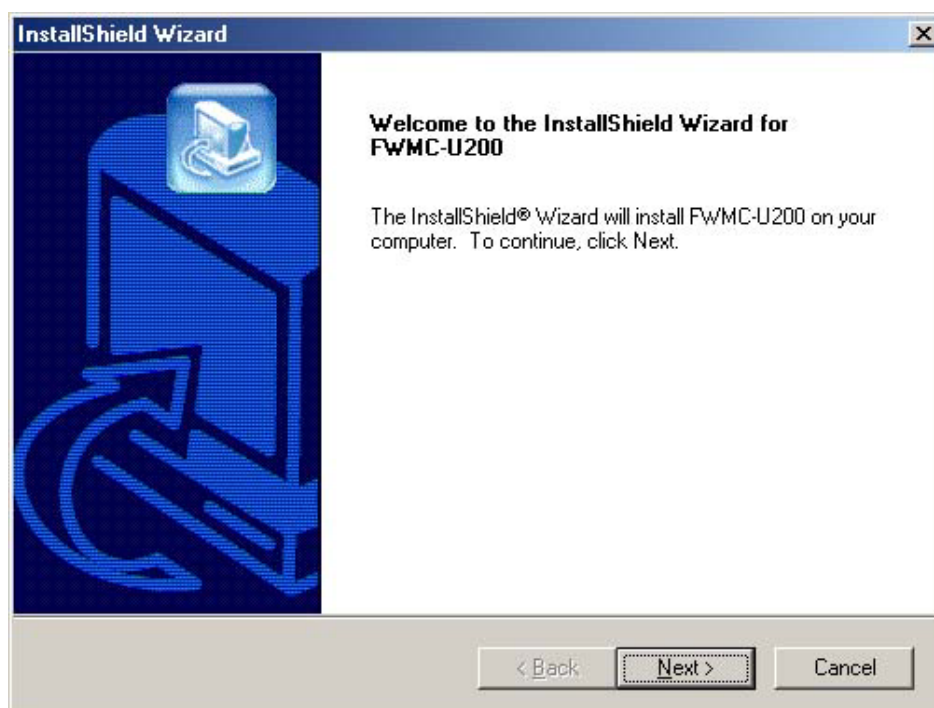
- Click **OK** and the installation program begins by presenting you with the selecting language.
- When the Choose Setup Language screen appears, you can choose to proceed with any of the following languages.



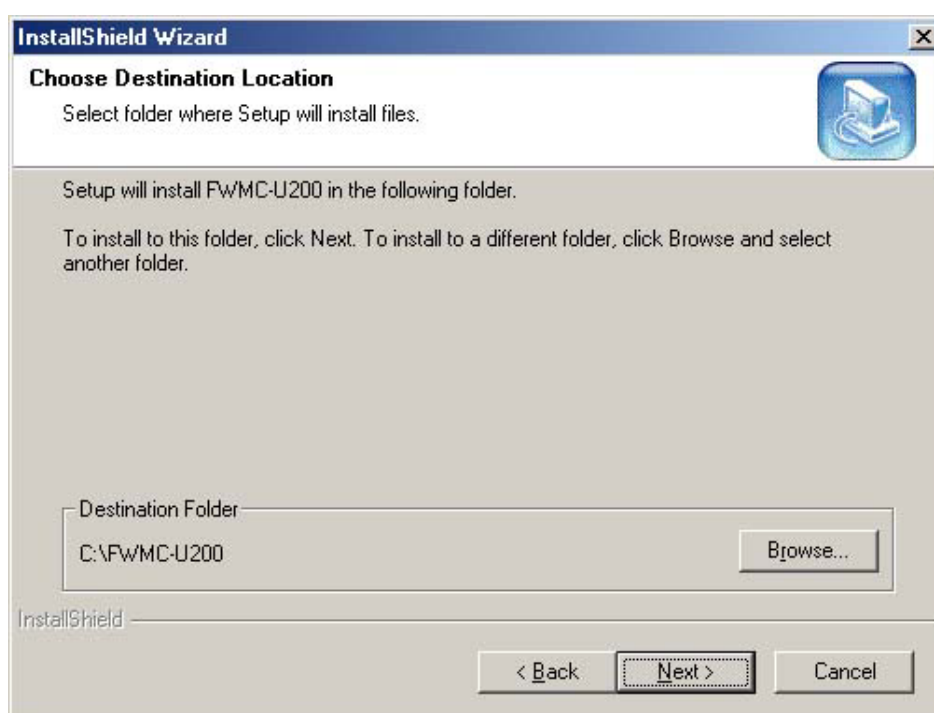
- The preparing wizard screen appears. Please wait.



- The installation program begins by presenting you with the starting installation. Click **Next** to continue. If you want to quit the installation, click **Cancel**.

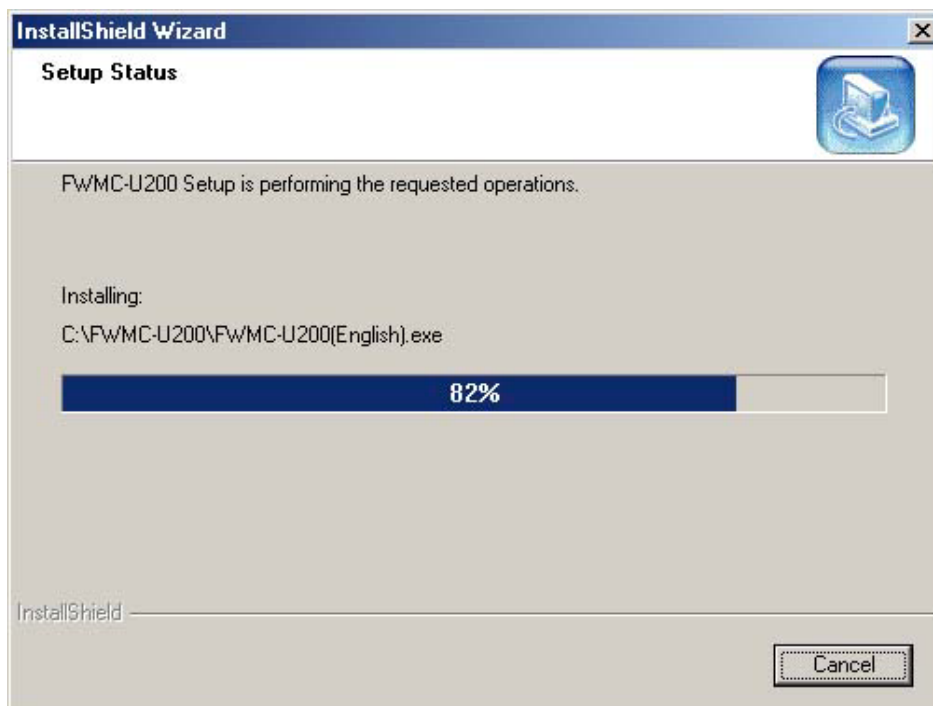


- You are given the option of installing the production in the default folder C:\FWMC-U200\ or choosing another folder. Click **Browse** to choose another folder, if needed. Click **Next** when the desired Destination Folder is selected. If you want to go the appropriate screen, click **Back**.

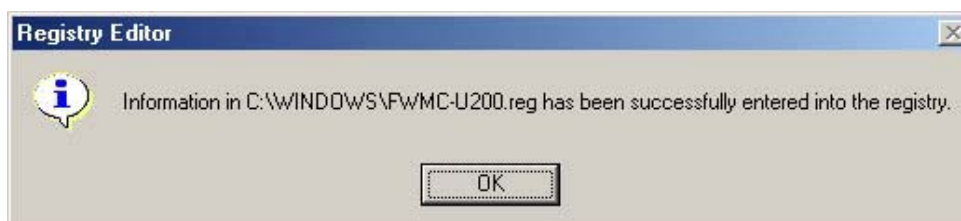


3. Installing Software

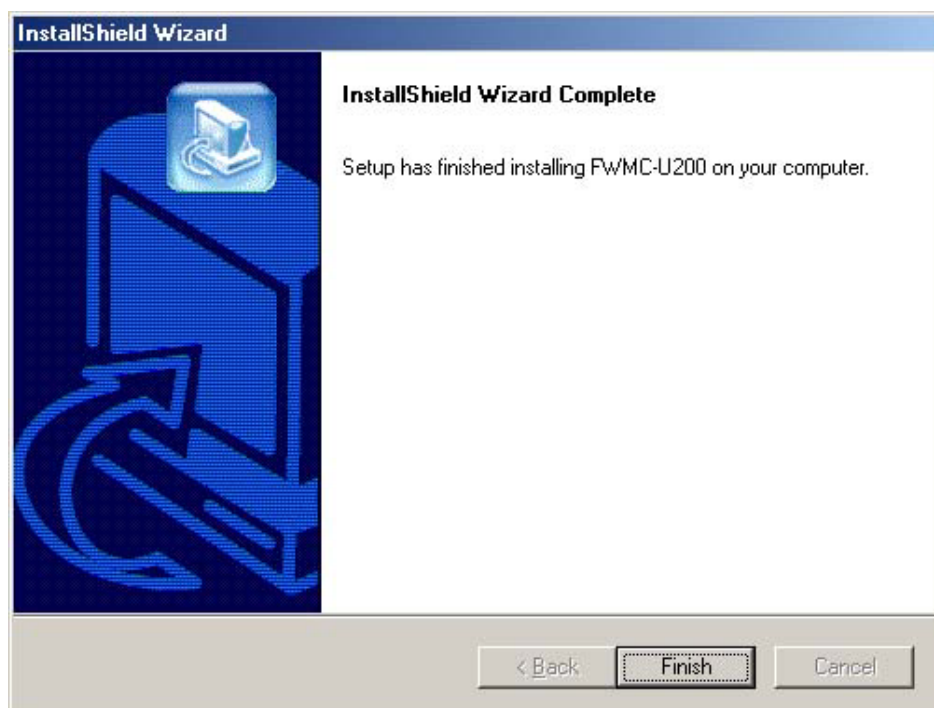
- The install program begins copying files. The Setup Status window appears.



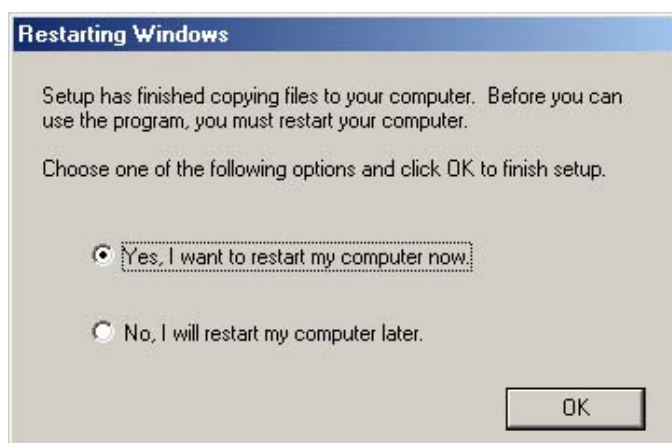
- After all files have been successfully copied, you are presented with a screen. The screen informs you whether you want to add the information to the registry. Click **Yes** and a screen appears. The screen informs you that information has been successfully entered into the registry. Click **OK**.



- The Setup Complete screen appears. Click **Finish**.



- When the Restarting window appears, you can choose whether you reboot your PC. Click the appropriate selection and then click **OK** to end the installation.



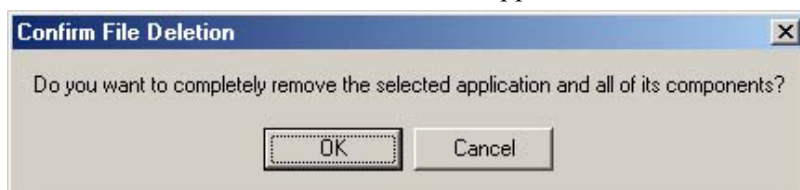
3.3. Uninstalling PCNC Software

To uninstall PCNC software, perform the following steps.

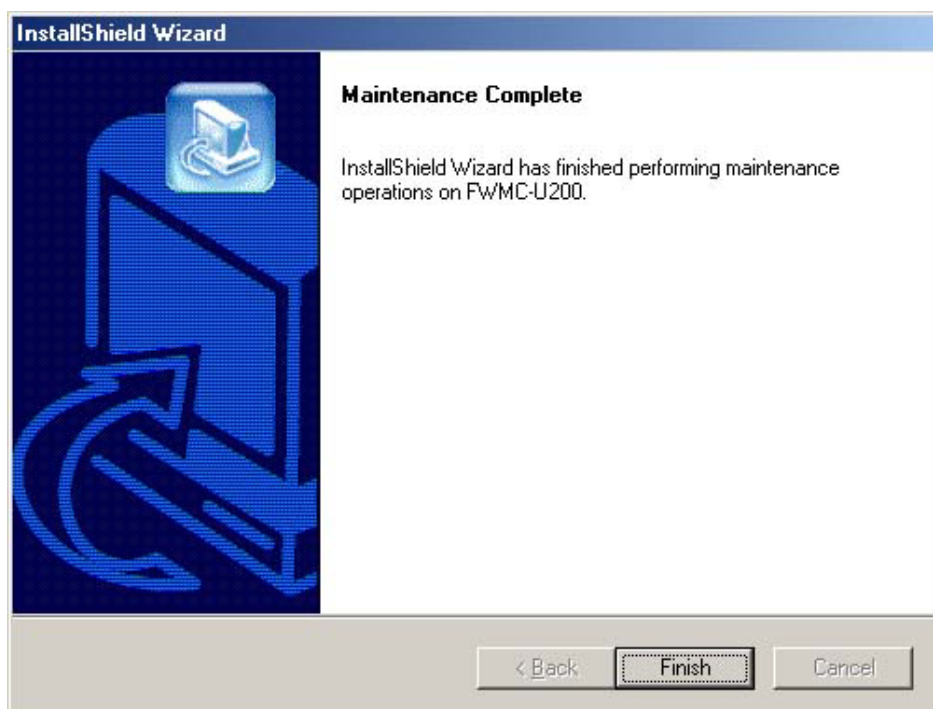
- Insert the PCNC software CD into the CD-ROM drive.
- Select **Start** → **Run**. Type *d:\setup.exe* in the Open field of the Run window. (If your CD-ROM drive is not “d” drive, substitute the appropriate drive designation.)



- When the Confirm File Deletion window appears, click **OK**.



- The Maintenance Complete screen appears. Click **Finish** to end.



3.4. Adding Device Driver

You must add device driver so that windows system detects the board. To add device driver, perform the following steps.

- Connect between PC and the board with a USB cable.
- Turn on the power of machine or board.
- If windows detect the new hardware normally, the Add New Hardware Wizard program starts. Click *Next*.



- Select the lower selection (*Display a list of all the drivers in a specific location, so you can select the drivers you want*). Click *Next*.



3. Installing Software

- Select *Universal Serial Bus controllers* item and then click *Next*.



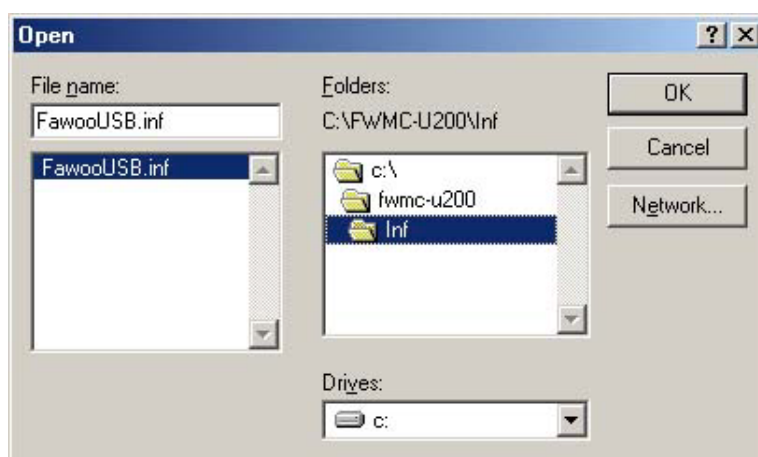
- Click *Have Disk*.



- When the Install From Disk window, click **Browse**.



- Select the folder has the device driver. The device driver is in the subfolder of the installation folder *c:\FWMC-U200\Inf*. Choose *FawooUSB.inf* in the file list and then click **OK**.



- Select *Fawoo USB Controller...* in the model field and then click **Next**.



3. Installing Software

- If the warning message for updating driver appears, click **Yes**.
- When the following window appears, Click **Next**.



- When the Complete screen appears, click **Finish** to end adding device driver.



Chapter 4.

Operating Program

4.1 Running Program

4.2 Interface Components

4.3 File Menu

4.4 Mode Menu

4.5 Graphic Menu

4.6 Control Menu

4.7 Setting Menu

4.8 Windows Menu

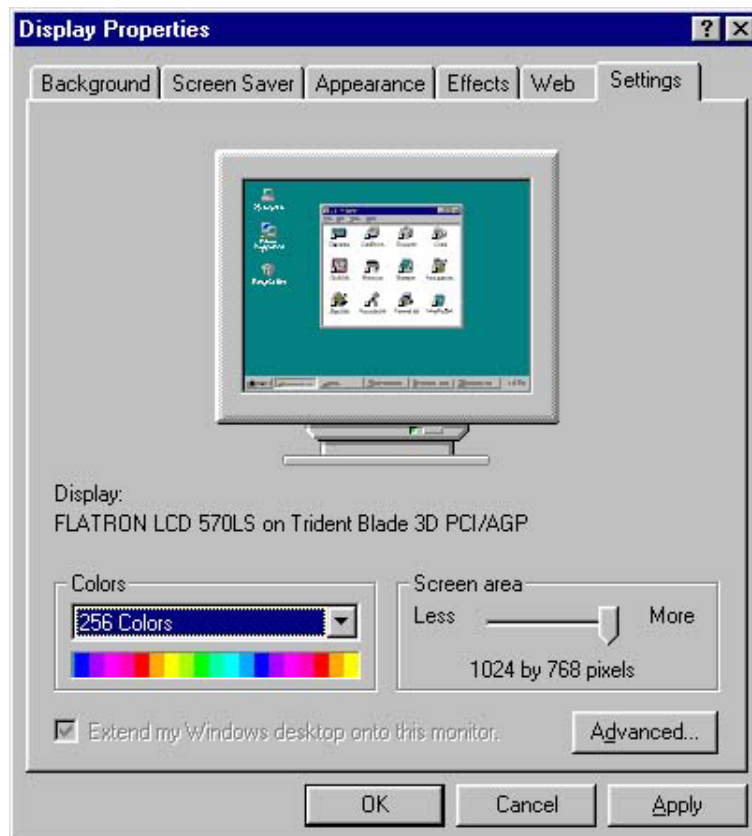
4.9 Mnemonic Keys

4.10 Command Line Input

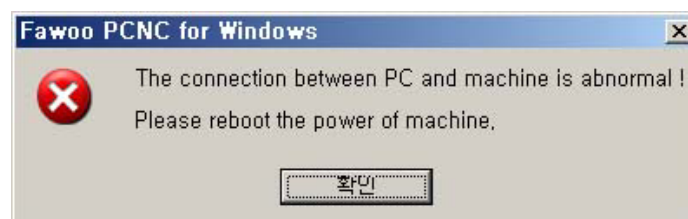
4. Operating Program

4.1. Running Program

Before running the program, make sure the current color setting of your computer is 256 colors. Select **Start** → **Setting** → **Control Panel** → **Display** to execute the Display Properties window. The 256-color setting is recommended for running the program. If you select the different color setting, the program may have a display-related problem.

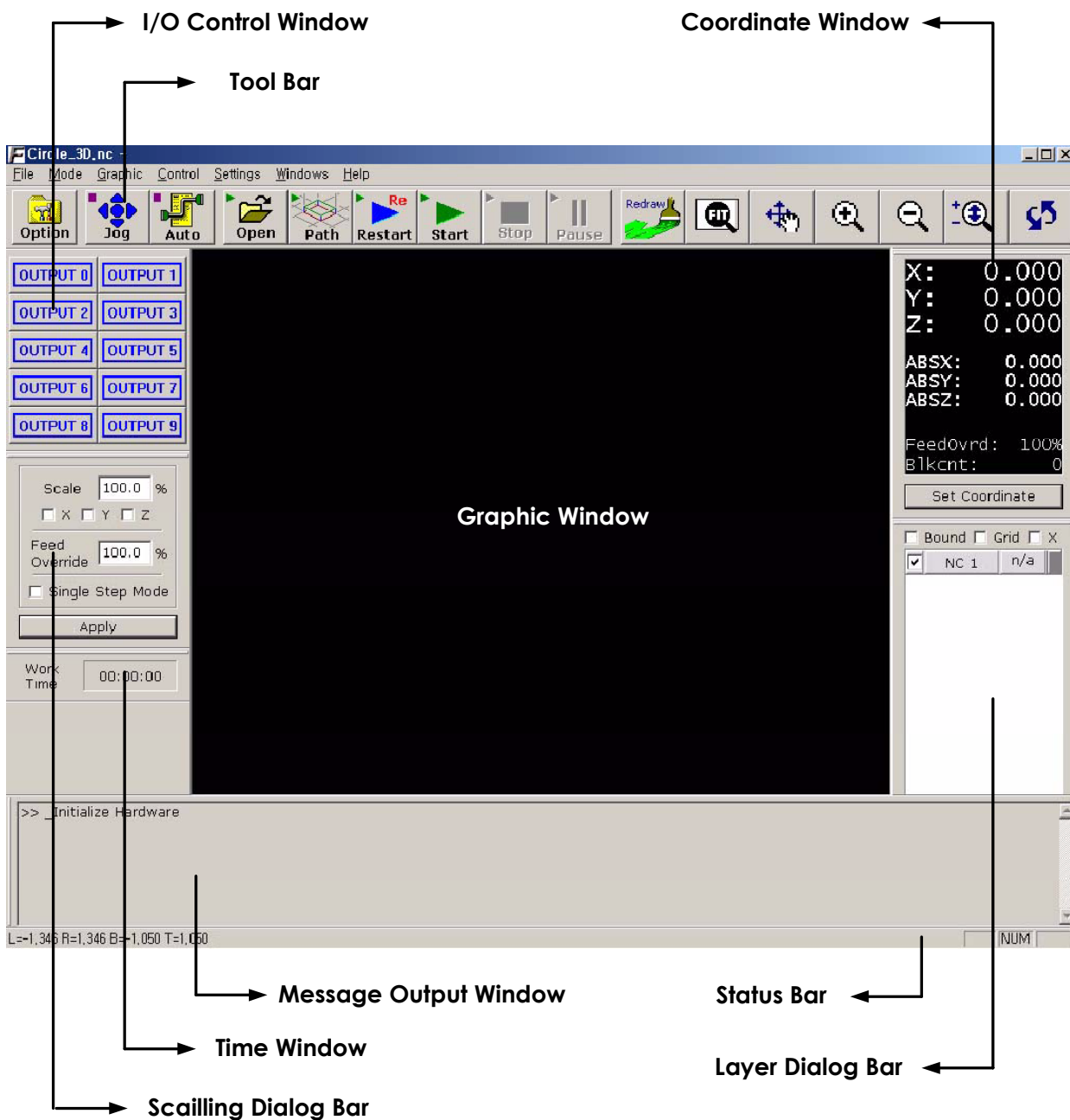


Run the program by clicking on its icon or double-clicking on 'FWMC-U200.exe' in the installation directory. Before running the program, make sure the machine is connected your computer by USB cable and the machine is turned on. If you do not such, the program does not run normally and the following dialog box is displayed on the screen.



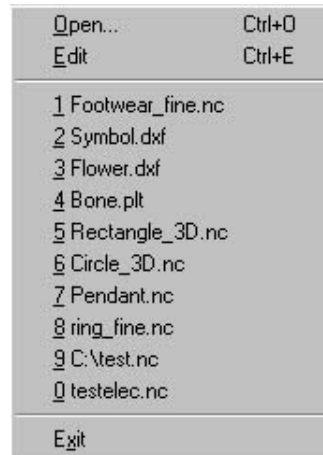
4.2. Interface Components

The following picture is the initial screen of PCNC program. It is composed of menu bar, tool bar, graphic window, coordinate window, message output window, time window, I/O Control window, Layer dialog bar, scaling dialog bar and status bar.



4.3. File Menu

Select **File** menu from the menu bar and the following pull-down menu are displayed. Each menu has a mnemonic key. Using this key, you can choose each menu more easily.



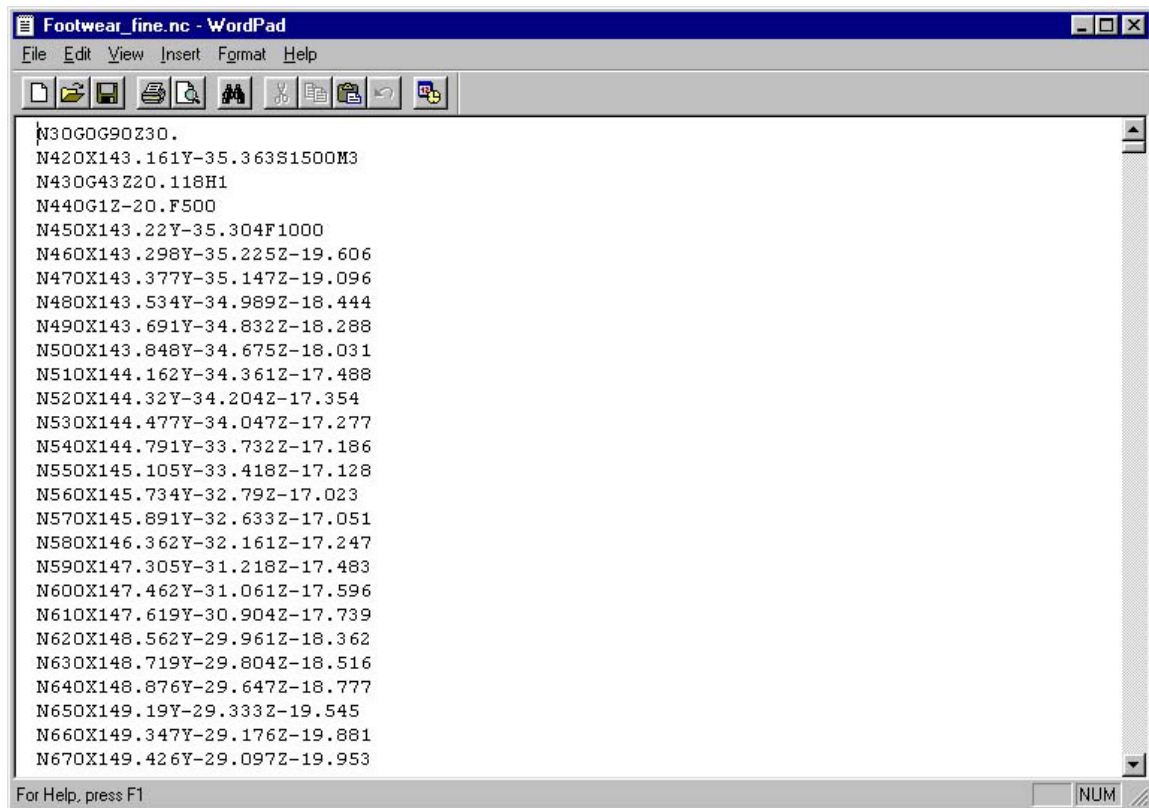
4.3.1. Open

Choose **Open** from the file menu and the program displays the Open dialog box. You can open the program file from this dialog-box. The Open dialog box only displays files of the supported file type. The program support DXF, PLT and NC file type.



4.3.2. Edit

Choose *Edit* from the file menu and the program displays the editor program (such as notepad). You can modify and save the current working file. If you modify and save it, you must open it again.



4.3.3. Most Recent Used File

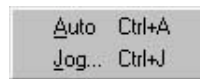
The program displays 10 MRU (Most Recently Used) files on the file menu. Choose this file from the file menu and you can open it more easily.

4.3.4. Exit

Choose *Exit* from the file menu and the program save all parameters and then terminate.

4.4. Mode Menu

Select **Mode** menu from the menu bar and the following pull-down menu are displayed.

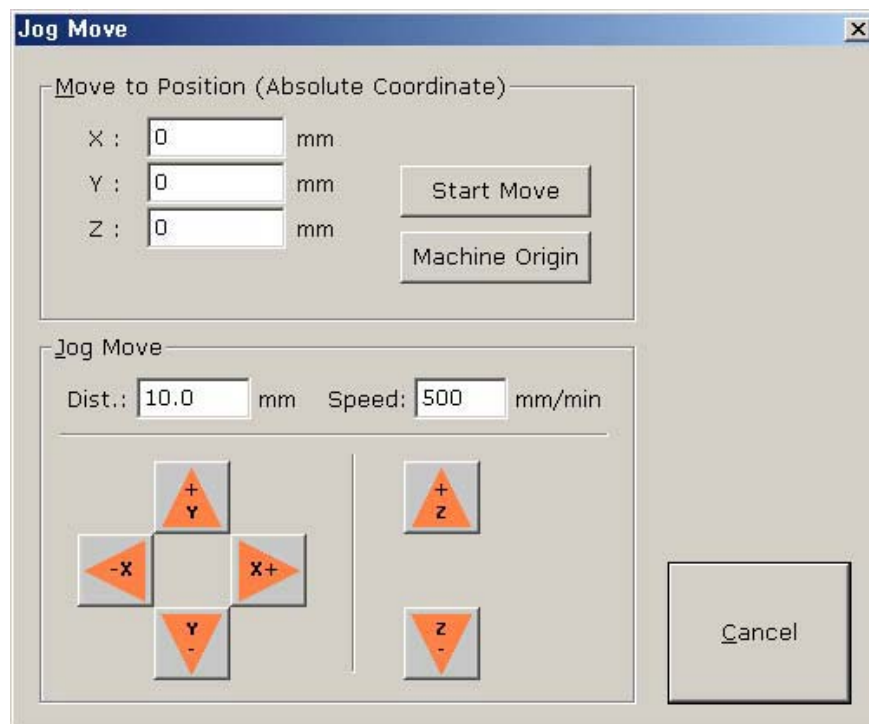


4.4.1. Auto

Choose **Auto** from the mode menu and you are ready to operate the program file. If you do not select this mode, you can't operate the program file. Also you can change mode to the auto mode with the operation panel attached to the machine. But if you want to change mode to the manual mode, you can only use the operation panel.

4.4.2. Jog

Choose **Jog** from the mode menu and the program displays the Jog Move dialog box. The Jog Move function operates like the jog movement in the manual mode. This function is only available in the auto mode.



- ▶ **Machine Origin:** Click this button and the machine return to the machine origin. When the machine finds the origin, the absolute coordinate system is initialized.
- ▶ **Move to Position:** Click this button and the machine moves to the specified position. The specified position is entered in X, Y, Z field. Of course, the specified position is the absolute position. For example, if you enter values (100, 100, -50) in X, Y, Z filed and click this button, the machine moves to the position.
- ▶ **Jog Move (X+ X- Y+ Y- Z+ Z-):** Click this button and the machine moves with the specified method. You can specify distance, direction and feed rate.

Note: The Jog Move function is only available in the auto mode. If the Jog Move function doesn't operate, make sure that the mode is the auto mode. If you set the feed rate excessively, the servo alarm may be occurred.

4.5. Graphic Menu

Select **Graphic** menu from the menu bar and the following pull-down menu are displayed.



4.5.1. Grid

Choose **Grid** from the graphic menu and grids are displayed on the graphic window. Grids enable you to know the size of the working model in the top view.

4.5.2. Position

Choose **Position** from the graphic menu and coordinate axes are displayed. Coordinate axes enable you to look the current position on the working mode in real time.

4.5.3. Bound

Choose **Bound** from the graphic menu and bounding boxes are displayed on the working model about each layer.

4.5.4. Redraw

Choose **Redraw** from the graphic menu and the display in the graphic window is redrawn. If you have a display-related problem (but trivial problem such as an afterimage effect), you can solve it by using this function.

4.5.5. View in Various Angle

Choose **View Options** from the graphic menu and the working model is displayed in various angles such as isometric view (45 degree), top view, front view, back view, right view and left view. You can know the shape of the working model conveniently.

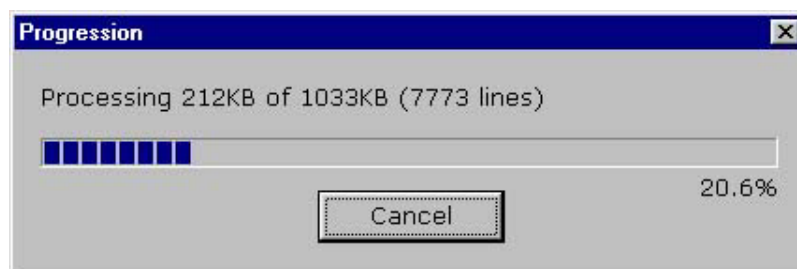
4.6. Control menu

Select **Control** menu from the menu bar and the following pull-down menu are displayed.



4.6.1. Tool Path

Choose **Tool Path** from the control menu and the program analyze the program file in advance and then draw a tool path. The tool path shows the process of working. Because of analyzing the program file beforehand, you can make sure the validity of the program data and the result of the working model. So you can save time and material. The Progression dialog box shown as below displays the rate of creating the tool path.



Note: It requires much time to create the tool path. Therefore, when the big-size program file is selected, you should pay attention to select the tool path menu.

4.6.2. Start

Choose **Start** from the control menu and the automatic operation begins. Before executing the start function, you should complete all the pre-setting for the machining. This function is only available in the auto mode.

4.6.3. Restart

When the automatic operation is stopped because of breaking tool, you should change the tool and start the automatic operation again. But it is very wasteful for time and cost. Especially, when the automatic operation is terminated abnormally after processing for a long time, it is very serious problem. To solve this problem, you can use the restart function. The restart function enable you to start the part of selected program file which you want again.

Choose **Restart** from the control menu and the program displays the Restart Block Number dialog box.



Enter the block number to restart and click the **OK** button. The program starts the automatic operation from the specified block number. This function is available in all file formats (NC, PLT and DXF). The program always shows the block number on the Coordinate window, so you can get the block number easily.

Note: In the case of a big-size program file, it is required much time (several minute) to restart.

4.6.4. Stop/Cancel

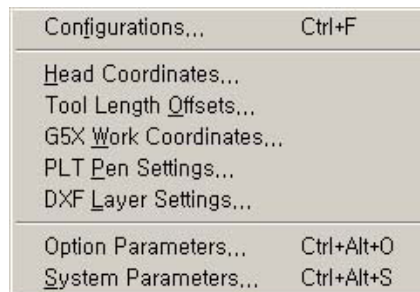
When the automatic operation is started, the Stop/Cancel menu is activated. Choose **Stop/Cancel** from the control menu and the automatic operation is terminated instantly. You can decide in the Configurations dialog box whether the machine returns to the origin or not.

4.6.5. Pause

When the automatic operation is started, the Pause menu is activated. Choose **Pause** from the control menu and the automatic operation is stopped at one time. If you want to start the automatic operation again, you select the Pause menu or the Start menu again.

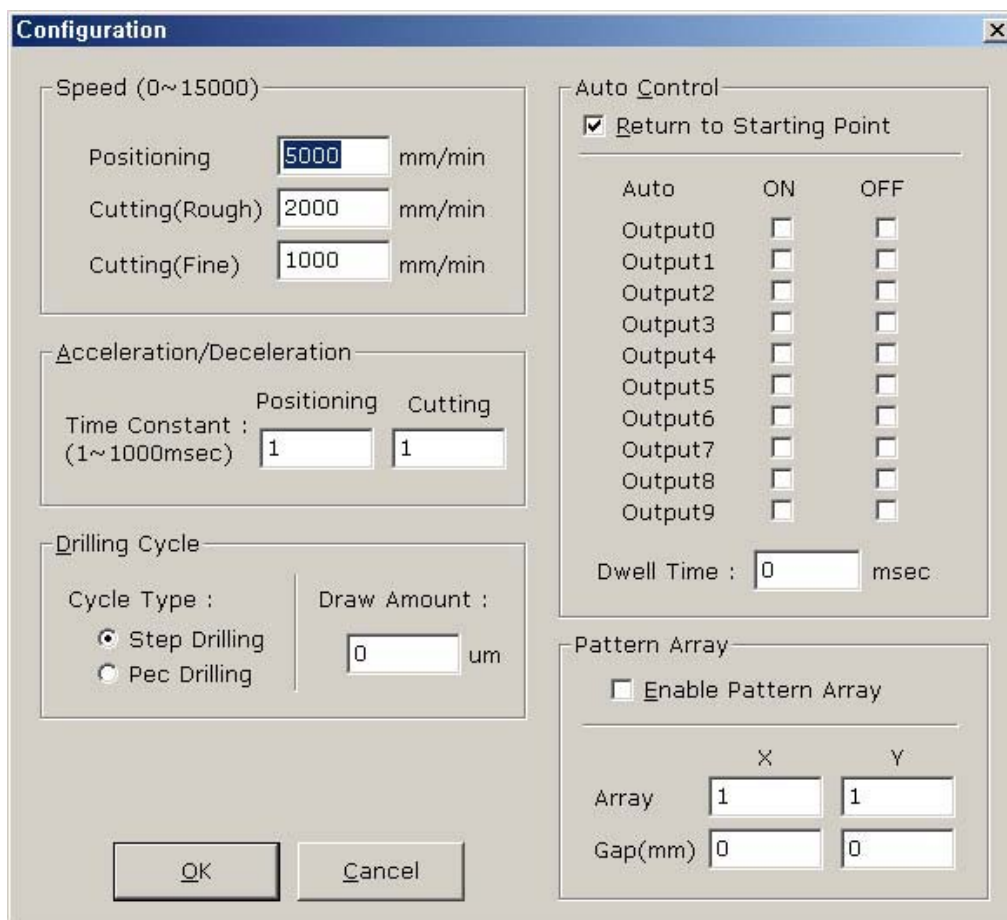
4.7. Setting Menu

Select **Setting** menu from the menu bar and the following pull-down menu are displayed.

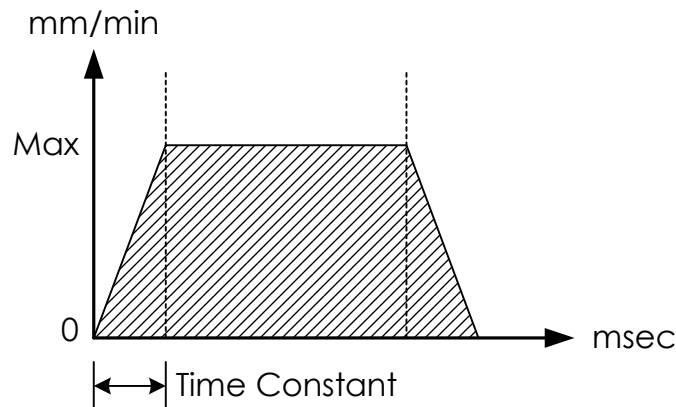


4.7.1. Configurations

Choose **Configurations** from the setting menu and the program displays the Configuration dialog box. It enable you to set parameters for the automatic operation.



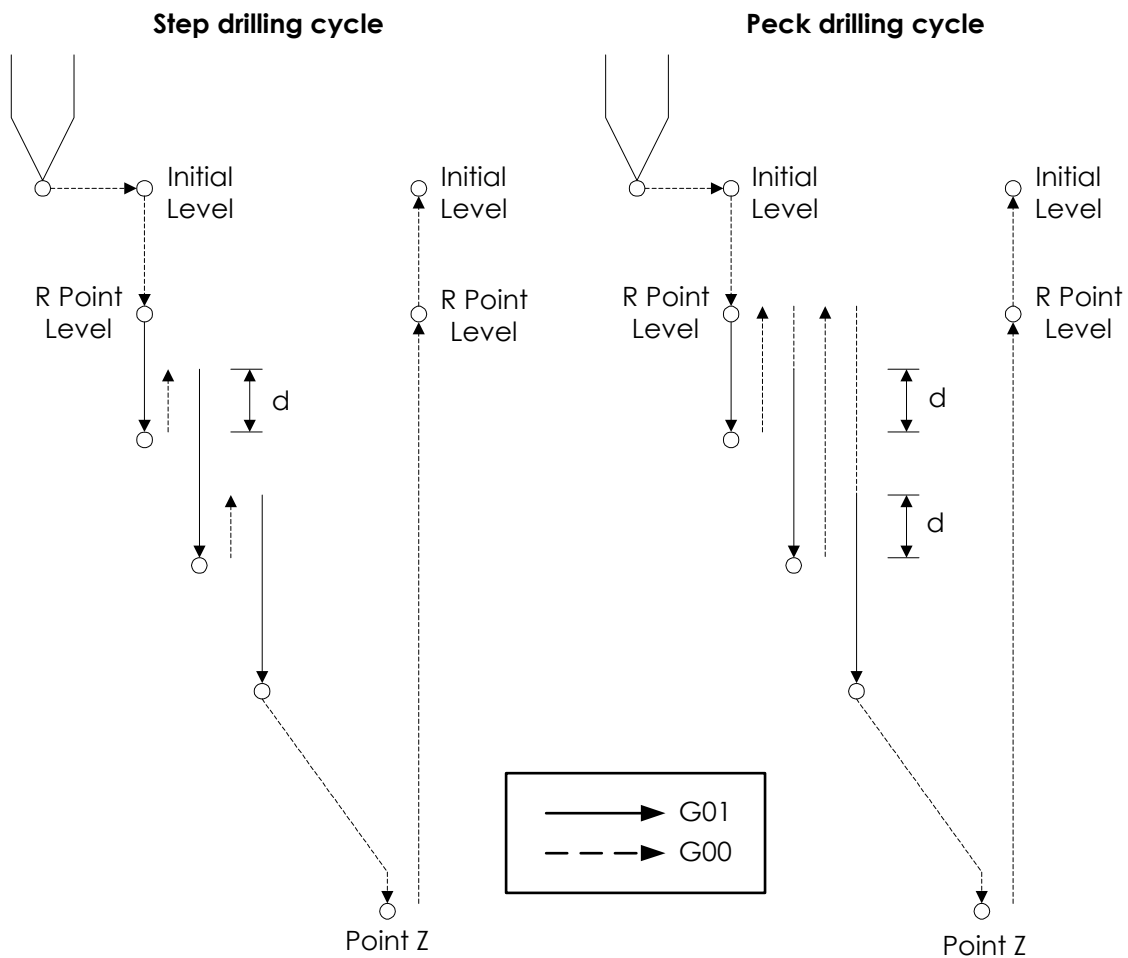
- **Speed:** You can set the speed of positioning and cutting (rough/finish). The speed of positioning is available to PLT, DXF and NC files. The speed of cutting is available to PLT and DXF files. In case of NC files, the speed of cutting is decided by F code in the NC file.
- **Acceleration/Deceleration:** You can set the time constant value for acceleration and deceleration. Acceleration is effected from the minimum speed to the maximum speed during the time constant. Deceleration is the opposite of acceleration.



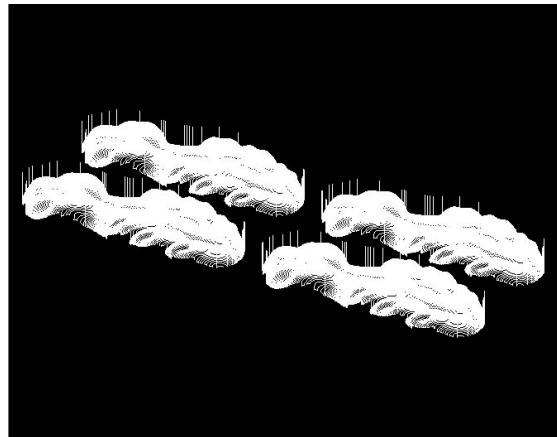
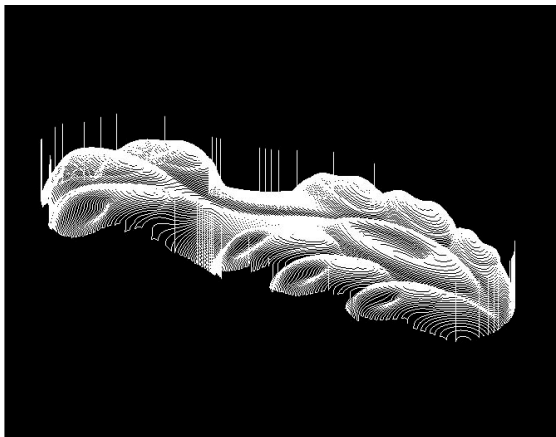
- **Auto Control:** The dwell time is a period from choosing the Start menu to beginning the automatic operation actually. The program waits for the dwell time after switching on I/O (Output0~Output9). If you check on or off each option (Output0~Output9), the program controls it automatically at the start and end of the automatic operation. In NC Files, you can control Output0~Output9 by using M codes. (Refer to Chapter 7. NC Programming)

Note: If you don't check the Auto Control option, each option doesn't switch on or off automatically.

- **Drilling Cycle:** This option is only applied to NC files. When G81, G83 codes are in the NC file, these values are available. The following picture is the relation between the method of drilling and the draw amount.



- **Pattern Array:** The Pattern Array function enables you to array the automatic operation without extra CAD/CAM software. If you check on the Enable Pattern Array option, the Pattern Array function is executed. This function is available in all file formats (NC, PLT and DXF). The following pictures are the original tool path data (left) and the 4×4 array tool path data (right).



4.7.2. Head Coordinates

Choose *Head Coordinates* from the setting menu and the program displays the Head Coordinates dialog box. This function is available in the 3-head machine attached the tool change option. You can make sure of each tool offset value and modify it.

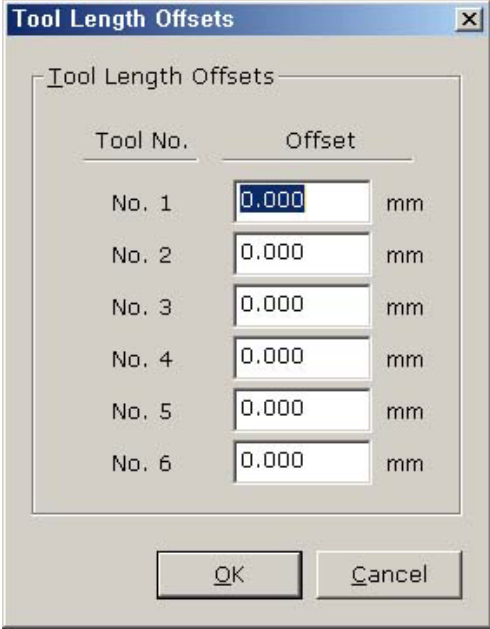
The dialog box is titled "Head Coordinate" and contains three sections for Tool.1, Tool.2, and Tool.3. Each section has three input fields for X, Y, and Z coordinates, all set to 0.000 mm. The X field for Tool.1 is highlighted with a blue selection box. At the bottom right, there are "OK" and "Cancel" buttons.

Tool	X (mm)	Y (mm)	Z (mm)
Tool.1	0.000	0.000	0.000
Tool.2	0.000	0.000	0.000
Tool.3	0.000	0.000	0.000

Note: Do not change the value without permission.

4.7.3. Tool Length Offsets

Choose *Tool Length Offsets* from the setting menu and the program displays the Tool Length Offsets dialog box. This function is available in the ATC machine attached the auto tool change option. You can make sure of each tool length offset value and modify it.



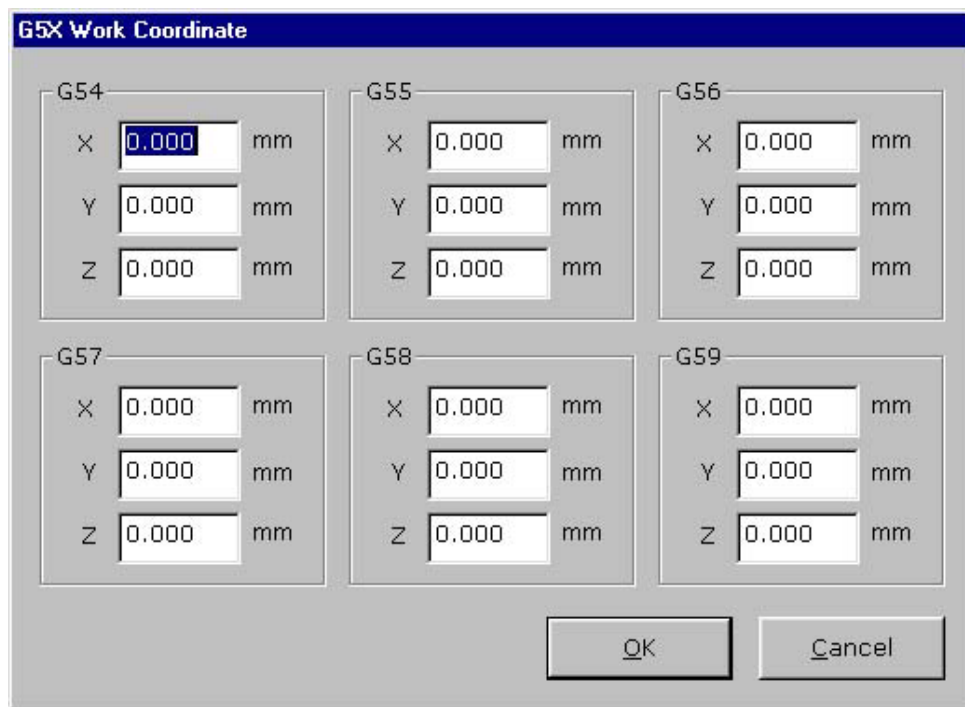
The image shows a software dialog box titled "Tool Length Offsets". It contains a table with two columns: "Tool No." and "Offset". There are six rows, numbered 1 to 6. Each row has a text input field for the offset value, followed by the unit "mm". The first row (Tool No. 1) has the value "0.000" selected. At the bottom of the dialog box are two buttons: "OK" and "Cancel".

Tool No.	Offset	
No. 1	0.000	mm
No. 2	0.000	mm
No. 3	0.000	mm
No. 4	0.000	mm
No. 5	0.000	mm
No. 6	0.000	mm

Note: When the tool is changed, the tool length offset is compensated automatically. The length offset of each tool is the relative value on the reference tool (Tool 1).

4.7.4. G5X Work Coordinates

Choose **G5X Work Coordinates** from the setting menu and the program displays the G5X Work Coordinates dialog box.



The dialog box titled "G5X Work Coordinate" contains six panels for setting work coordinates G54 through G59. Each panel has three input fields for X, Y, and Z coordinates, all set to 0.000 mm. The G54 panel has the X field highlighted. At the bottom right are "OK" and "Cancel" buttons.

Coordinate	X (mm)	Y (mm)	Z (mm)
G54	0.000	0.000	0.000
G55	0.000	0.000	0.000
G56	0.000	0.000	0.000
G57	0.000	0.000	0.000
G58	0.000	0.000	0.000
G59	0.000	0.000	0.000

- **G54 ~ G59:** You can set proper work coordinates in G54~G59 fields. You can use one of the 6 work coordinates as the need arises. This function is only available in NC files.

4.7.5. PLT Pen Settings

Choose **PLT Pen Settings** from the setting menu and the program displays the PLT Pen Settings dialog box. If you click on the Layer dialog bar after opening the PLT file, the program also displays the PLT Pen Settings dialog box. You can set the property on each layer before starting the automatic operation with the PLT file.

Pen No.	FeedType	Depth	Repeat	Total
Pen.1	Rough	0.000	X 1	0.000
Pen.2	Rough	0.000	X 1	0.000
Pen.3	Rough	0.000	X 1	0.000
Pen.4	Rough	0.000	X 1	0.000
Pen.5	Rough	0.000	X 1	0.000
Pen.6	Rough	0.000	X 1	0.000
Pen.7	Rough	0.000	X 1	0.000
Pen.8	Rough	0.000	X 1	0.000
Pen.9	Rough	0.000	X 1	0.000
Pen.10	Rough	0.000	X 1	0.000

☐ Use same pen depth

Depth: 1.000

Repeat: 1

Pen No.: Pen.1

Depth: 0.000

Repeat: 1

FeedType: Rough

Apply

Close

In case of PLT files, you can set the depth to cut on each layer. Select the pen that you want to modify on the list and set the depth to cut. Then click on the **Apply** button to save all properties.

- **Use same pen depth:** If you check on this box and set the depth to cut, all layers are applied to the same value.
- **Repeat:** In case of operating the PLT file, you can perform the automatic operation repeatedly with the repeat count. For example, if the total depth to cut is 4.5mm and you want to divide it into three steps, you should set the repeat up 3 and set the depth up 1.5mm.
- **Feed Type:** If the selected file is constituted of many cutting types, you can set the speed up the rough cutting or the fine cutting on each layer.

4.7.6. DXF Layer Setting

Choose **DXF Layer Settings** from the setting menu and the program displays the DXF Layer Setting dialog box. If you click on the Layer dialog bar after opening the DXF file, the program also displays the DXF Layer Settings dialog box. You can set the property on each layer before starting the automatic operation with the DXF file.

Layer No.	FeedType	Tool No.	X	Y
Pen.1	Rough	T01	0.000	0.000
Pen.2	Rough	T01	0.000	0.000
Pen.3	Rough	T01	0.000	0.000
Pen.4	Rough	T01	0.000	0.000
Pen.5	Rough	T01	0.000	0.000
Pen.6	Rough	T01	0.000	0.000
Pen.7	Rough	T01	0.000	0.000
Pen.8	Rough	T01	0.000	0.000
Pen.9	Rough	T01	0.000	0.000
Pen.10	Rough	T01	0.000	0.000

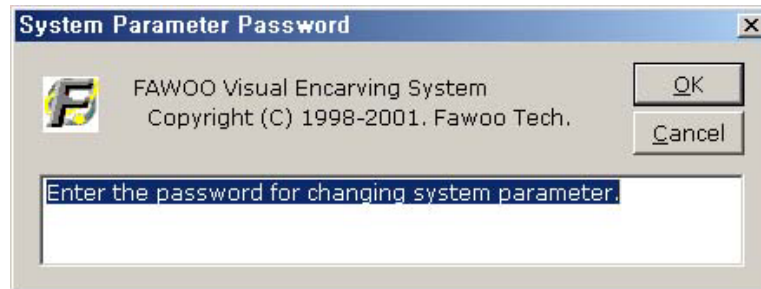
Layer No. Pen.1
FeedType Rough
Tool No. Tool.1
0.000
0.000
0.000
Apply
Close

- ▶ **Feed Type:** If the selected file is constituted of many cutting types, you can set the speed up the rough cutting or the fine cutting on each layer.
- ▶ **Tool No:** This setting is only available in the 3-Head machine attached the tool change option. You can set the tool offset in the Head Coordinates dialog box.

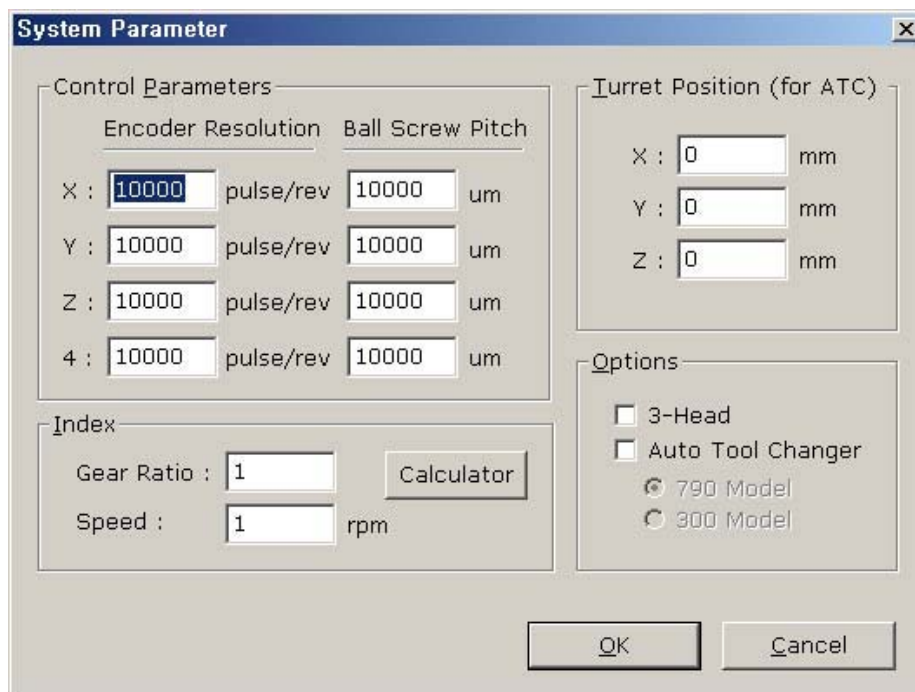
Click on the **Apply** button and all properties are saved.

4.7.7. System Parameters

Choose **System Parameters** from the setting menu and the program displays the message box to ask the password to change the system parameters. It is required the password to change the system parameters. Do not change the value without permission. **The password is 'fawoo'.**



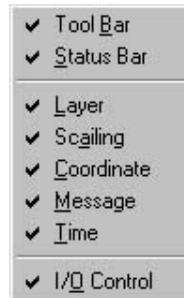
If you enter correct password, the program displays the System Parameter dialog box as shown below. You can change only the Control Parameters and the Index. Press **OK** and all parameters are saved. But the changed parameters are applied when the PCNC program restarts.



If you install the 4th axis, you can use the 4th axis as the index by using A or B address in NC file format. A or B address is commanded by the degree to rotate.

4.8. Windows Menu

Select **Windows** menu from the menu bar and the following pull-down menu are displayed. The PCNC program shows all windows by default. If you don't check some window in the menu, it is disappeared in the screen.



4.8.1. Tool Bar

Tool Bar is the set of buttons that you click. It carries out common tasks in the program. Each function of buttons is like the following.



Option: Click this button and the program displays the **Configuration** dialog box.



Jog: Click this button and the program displays the **Jog Move** dialog box.



Auto: Click this button and the control mode is changed to the auto mode.



Open: Click this button and the program displays The **Open** dialog box.



Path: Click this button and the program shows the **Tool Path** beforehand.



Start: Click this button and the program starts the automatic operation.



Restart: Click this button and the program starts the automatic operation from the block number you want to start.



Stop: Click this button and the program terminates the automatic operation. You can decide in the Configurations menu whether the machine return to the origin or not.



Pause: Click this button and the automatic operation is stopped temporarily. If you want to start the automatic operation again, you select the Pause button or the Start button again.



Redraw: Click this button and the program refreshes the display in the Graphic window. If you have a display-related problem (but trivial problem such as an afterimage effect), you can solve it by using the Redraw button.



FIT: Click this button and the program draws the tool path fit to the Graphic window.



Pan in real time: Click this button and you can pan the tool path to a new location by clicking the tool path and moving the pointing device with holding down the pick button.



Zoom in: Click this button and the tool path is increased.



Zoom out: Click this button and the tool path is decreased.



Zoom in real time: Click this button and you can zoom in or out of the tool path by moving the cursor up or down vertically.

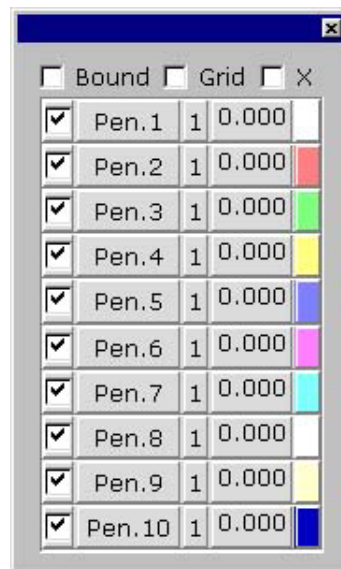


Rotate: Click this button and you can rotate the view of Tool Path in real time.

4.8.2. Status Bar

The status bar located at the bottom of the program displays the explanation of menus and the size of working model (left, right, bottom and top size) and so on.

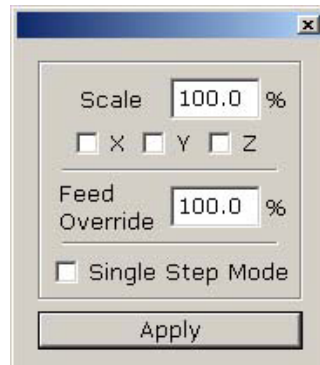
4.8.3. Layer Dialog Bar



You can set the left-side check boxes for on or off. This option enables the program to operate only the layer you want to operate. The content of the Layer dialog-bar is different as to DXF, PLT and NC files. Click on this and the program displays different dialog boxes as to each file (PLT file – PLT Pen Setting, DXF file - DXF Layer Setting, NC file - G5X Work Coordinates).

- ▶ **Bound:** Select this option and the program displays the boundary box of the layer.
- ▶ **Grid:** Select this option and the program displays grids in the Graphic window.
- ▶ **X:** Select this option and the program displays coordinate axes. It enables you to look the current position in real time.

4.8.4. Scaling Dialog Bar



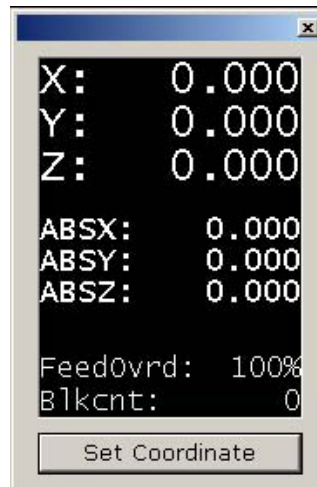
You can enlarge or reduce the real size of the working model in NC, PLT and DXF files. Each axis can be selected separately. The scale factor and the feed override value are entered in percent (%). The scaling is only performed about the selected axis. But if there are G02, G03 codes in NC files or Arc, Circle entity in DXF files, you must select X, Y axis at the same time.

Note: Don't enter the excessive value on the feed override field. If you set the feed override to the excessive value, the servo motor take a heavy load and then the servo alarm may occur.

Note: In case of setting Z-axis, you must enter the value carefully.

- **Single Step Mode:** This function stops the machine after executing one block of the program. One block of the program is executed and then the execution is stopped. If the start button is pressed, the next block is executed and then the execution is stopped again.

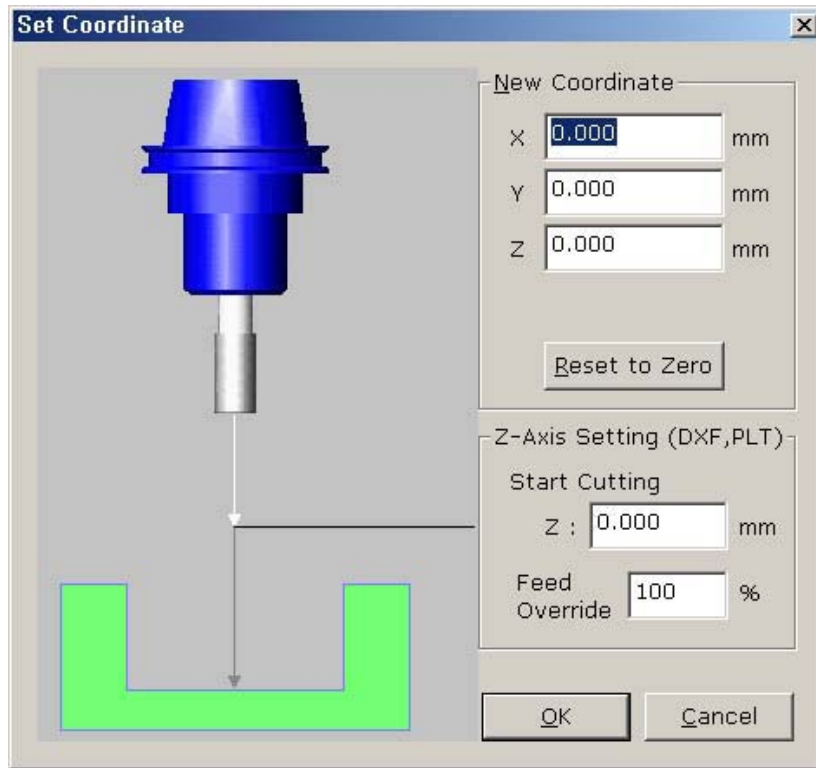
4.8.5. Coordinate Window



This window displays the current relative coordinates, the current absolute coordinates and the block number.

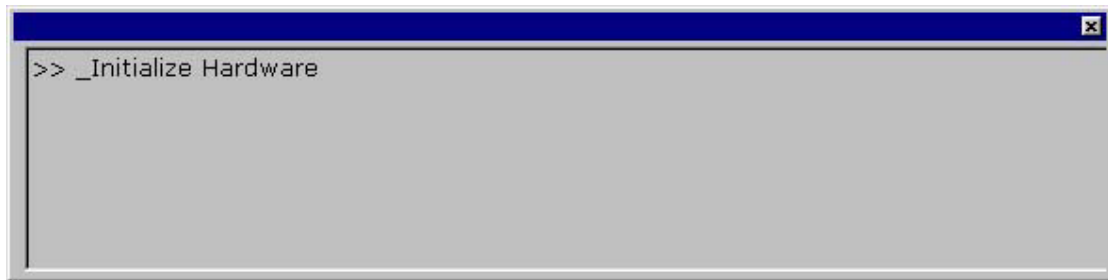
- ▶ **X, Y and Z:** Display the relative coordinates set by user.
- ▶ **ABSX, ABSY and ABSZ:** Display the current absolute coordinates from the machine origin.
- ▶ **FeedOvr:** Display the actual feed override.
- ▶ **BLKCNT:** Display the block number of the automatic operating.

Click **Set Coordinate** button and the program displays the following dialog box. You can set the relative coordinate system.



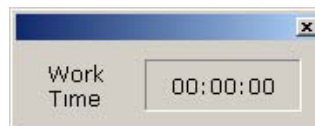
- ▶ **New Coordinate:** This value is the relative coordinates and you can specify the offset value as to the working model. Click **OK** button and the relative coordinate system are set for the entered value. Click **Reset to Zero** button and all coordinates are set for Zero (0).
- ▶ **Z-Axis Setting:** If you consider the cutting of Z-Axis direction, the speed is more slowly. Therefore you should set the starting position to cut. The machine move to the setting position by the positioning speed and the machine move by the cutting speed after that time.

4.8.6. Message Output Window



This window displays the information about the machine status and the program status. You can get the information for working such as the Min/Max value of the working model easily.

4.8.7. Time Window



This window displays the time of the automatic operation, so you can know the working time by using it. If you click on window, you can know various types of time (working time, starting time, finishing time and current time).

4.8.8. I/O Control Window



You can control outputs (Output0~Output9) by using buttons on this window. You can also control by using the Configuration dialog box and M codes.

(Refer to Chapter 7. NC Programming)

4.9. Mnemonic Keys

The mnemonic key is defined to each menu, so you can perform a function by pressing a single key. You can also use the mnemonic key shown in the following table.

Mnemonic key	Function
Ctrl + O	File Open
Ctrl + E	File Edit
Ctrl + A	Auto Mode
Ctrl + J	Jog Move
Ctrl + T	Show Tool-path
Ctrl + R	Restart
Ctrl + S	Start
Ctrl + C	Stop
Ctrl + P	Pause
Ctrl + F	Set Configurations
Ctrl + Alt + S	System Parameter

You can also select the menu by using keyboard shortcuts. For example, if you want to open a file, press on Alt+F+O successively.

4.10. Command Line Input

The program supports the command line input in the status bar. For example, if you enter 'open' in command line and then press 'enter' key, the program displays the Open dialog box. The following command list is available in the program. ('↵' means the Enter key and 'Esc' means the Escape key.)

Command	Function
"open" + '↵'	File Open
"load" + '↵'	File Open
"o" + '↵'	File Open
"edit" + '↵'	File Edit
"e" + '↵'	File Edit
"auto" + '↵'	Auto Mode
"a" + '↵'	Auto Mode
"jog" + '↵'	Jog Move
"j" + '↵'	Jog Move
"start" + '↵'	Start
"s" + '↵'	Start
"'" + '↵'	Start
"restart" + '↵'	Restart
"r" + '↵'	Restart
"stop" + '↵'	Stop
'Esc'	Stop
"c" + '↵'	Stop
"pause" + '↵'	Pause
"p" + '↵'	Pause
"toolpath" + '↵'	Show Tool-path
"t" + '↵'	Show Tool-path
"option" + '↵'	Set Configurations
"config" + '↵'	Set Configurations
"f" + '↵'	Set Configurations

Command	Function
“out0” + ‘↵’	Output0 On/Off
“out1” + ‘↵’	Output1 On/Off
“out2” + ‘↵’	Output2On/Off
“out3” + ‘↵’	Output3 On/Off
“out4” + ‘↵’	Output4 On/Off
“out5” + ‘↵’	Output5 On/Off
“out6” + ‘↵’	Output6 On/Off
“out7” + ‘↵’	Output7 On/Off
“out8” + ‘↵’	Output8 On/Off
“out9” + ‘↵’	Output9 On/Off
“mru1” + ‘↵’	Most recent used file 1
“mru2” + ‘↵’	Most recent used file 2
“mru3” + ‘↵’	Most recent used file 3
“mru4” + ‘↵’	Most recent used file 4

Note: To recognize the entered command, the program must have a focus of cursor.

Chapter 5.

Remote Terminal (Optional)

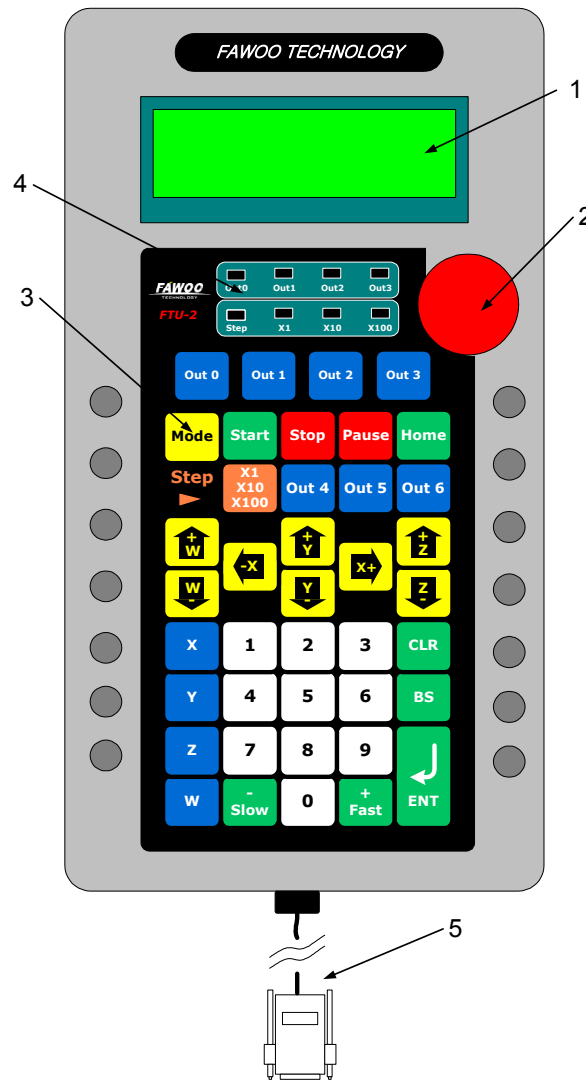
5.1 Specification

5.2 Keys of Remote Terminal

5.3 Usage of Remote Terminal

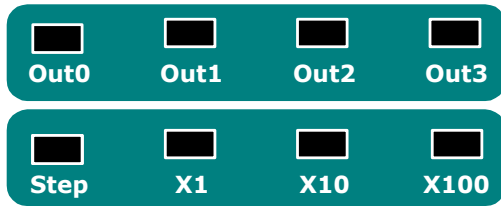
5. Remote Terminal (Optional)

5.1. Specification

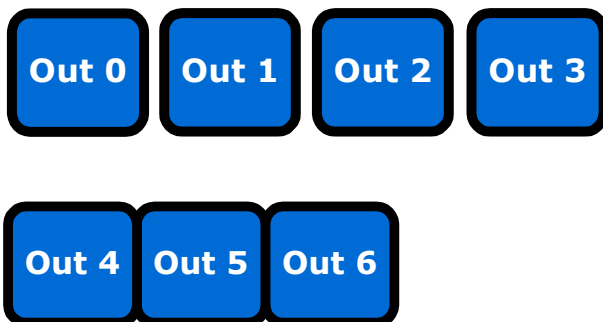


1. **LCD Screen:** This screen displays the current values of machine coordinate, the status of I/O (Motor, Air, Vacuum On/Off), and the current mode.
2. **Emergency Switch:** If you press *EMEGENCY* switch on the operation panel, the operation of board is stopped.
3. **Mode Selection Button:** There are two modes. One is the auto mode and the other is the manual mode.
4. **Status Display LED:** Four LED on the upper indicate the status of output (Out0-3). Four LED on the lower indicate the amount of step mode.
5. **9-Pin Connector:** This connector is coupled on the board.

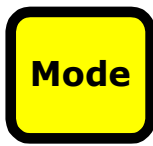
5.2. Keys of Remote Terminal



- ▶ **Out0:** It represents the output 0 status. If the LED is on, this means output 0 is on and if the LED is off, this means output 0 is off.
- ▶ **Out1:** It represents the output 1 status. If the LED is on, this means output 1 is on and if the LED is off, this means output 1 is off.
- ▶ **Out2:** It represents the output 2 status. If the LED is on, this means output 2 is on and if the LED is off, this means output 0 is off.
- ▶ **Out3:** It represents the output 3 status. If the LED is on, this means output 3 is on and if the LED is off, this means output 0 is off.
- ▶ **Step:** It represents the mode of jog. If the LED is on, the mode of jog is step jog and if the LED is off, it is continuous jog.
- ▶ **x1:** This LED is only on when the mode of jog is step jog. The machine moves $1\mu\text{m}$ for each step.
- ▶ **x10:** This LED is only on when the mode of jog is step jog. The machine moves $10\mu\text{m}$ for each step.
- ▶ **x100:** This LED is only on when the mode of jog is step jog. The machine moves $100\mu\text{m}$ for each step.



- ▶ Press this button to turn on the out0-6 and LED,. Press once more to turn off the out0-6 and LED.



- ▶ Press this button to select the auto mode or the manual mode.



- ▶ Only use in the auto mode. Press this key to start the automatic operation. This button is available after the program file is selected in the PCNC.



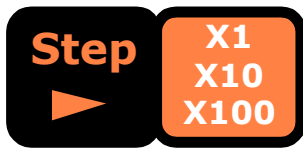
- ▶ Only use in the auto mode. Press this key to stop the automatic operation.



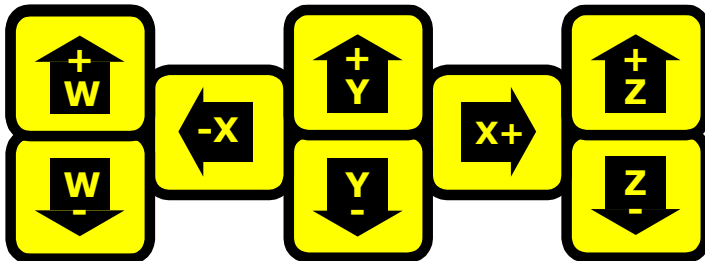
- ▶ Only use during in the auto mode. Press this key to pause the automatic operation. If you want to continue the automatic operation, press this key or the *Start* key again.



- ▶ Press this key to find the machine origin.



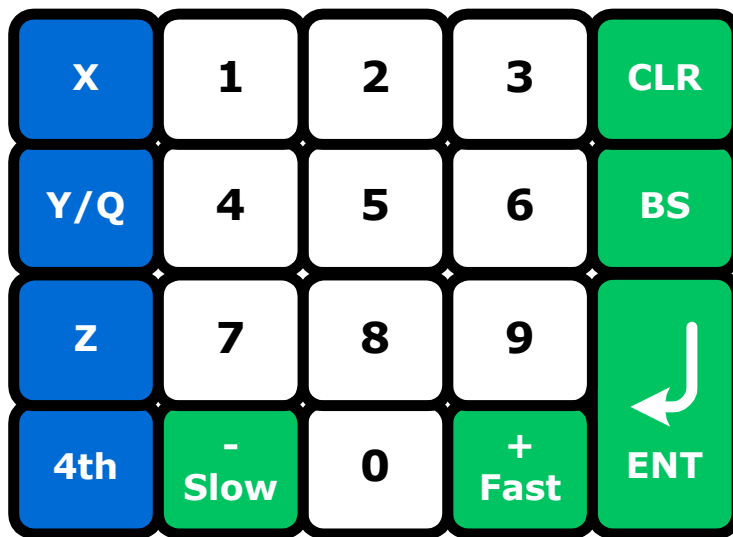
- ▶ The **Step** key is useful to operate the machine without MPG (Manual Pulse Generator). When the jog key is pressed once, the selected axis moves to its direction by the specified amount.
- ▶ $\times 1$, $\times 10$, $\times 100$ keys set the amount to move. According to these buttons, the status LED is on or off.
- ▶ For example, if the $X+$ jog key is pressed once in the step mode (default is $\times 10$), X-axis moves $10\mu\text{m}$ to + direction.



- ▶ You can move the selected axis continuously during pressing these keys. The selected axis moves to its direction. The jog operation is allowed for one axis at a time.



- ▶ These buttons are used to set the jog feed in the manual mode. Press the **Slow** key and the jog feed is slower than the current feed. Press the **Fast** key and the jog feed is faster than the current feed.
- ▶ Also these buttons work same as the feed override switch in the auto mode. Press the **Fast** key to accelerate the feed. Press the **Slow** key to decelerate the feed. The working range is 16 (0-15).



- ▶ Press these keys to input alphabets and digits in the manual mode.
- ▶ For example, if you press **X+100** and then press the **Enter** key, X-axis moves 100 μm to + direction.
- ▶ You can edit the input command easy by using the **BS** key and cancel the input command by using the **CLR** key.

5.3. Usage of Remote Terminal

5.3.1. Initial Mode

When the machine power turns on at first time, the LCD screen displays as shown below.

FAWOO CNC CONTROLLER
PCNC USB VER. R2.0.0
OPT : ____T____Q
=== 2002. 04. 26 ===

■ **PCNC USB VER. R2.0.0:** This means the version of ROM on the board.

■ **Option:**

D: Displayed by 10μm unit (but 1μm control)..

E: The pulse count of motor encoder is 4000 (Default is 10000).

M: Installing MPG (Manual Pulse Generator).

T: Installing FTU (FTU is the remote terminal).

F: Installing the foot start switch.

HB: Installing 1 or 2 1.5kW high frequency spindle(s).

HE: Installing 3 or 4 1.5kW high frequency spindle(s).

IB: Installing 1 or 2 1.8kW high frequency spindle(s).

IE: Installing 3 or 4 1.8kW high frequency spindle(s).

HK: Installing a 3kW high frequency spindle.

S: Installing step motor

C: Installing the cylinder for a big machine.

L: Using limit switches as A contact.

X: Ignoring the servo alarm of X-axis.

Y: Ignoring the servo alarm of Y- axis.

Z: Ignoring the servo alarm of Z- axis.

Q: Ignoring the servo alarm of 4th-axis.

■ **2002.04.26:** This means the date of making ROM.

When the board is this status, it is waiting for executing the PCNC program in PC.

5.3.2. Manual Mode

When the PCNC program is executed in PC, the operating mode is changed to the manual mode automatically. The LCD screen is displayed as shown below and is waiting for the commands.

```

X+0000.001Y+0001.234
Z+0000.000
COMMAND>
*** JOG Mode ***

```

Origin

You must find the machine origin by using **HOME** key at the first time after turning on the machine power. If you press **HOME** key, the LCD screen displays as shown below and the machine finds the origin of each axis (X, Y, Z). When the machine has found the origin completely, the LCD screen is changed to the manual mode and is waiting for the commands.

```

X+0000.001
Y+0001.234
Z+0000.000
***** HOME *****

```

Move Axis by Jogs

By using the jog (**X- X+ Y- Y+ Z- Z+**) key, you can move the selected axis. During pressing the jog key, the selected axis is moving continuously. You can control the jog speed to select the proper speed. If you press 'Fast' or 'Slow' key to control the jog speed, the LCD screen displays as shown below.

```

X+0000.001Y+0001.234
Z+0000.000
SPEED:■■■■■
*** JOG Mode ***

```

Press 'Fast' key and the jog speed is up. Press 'Slow' key and the jog speed is down. Default is 5 steps

Note:

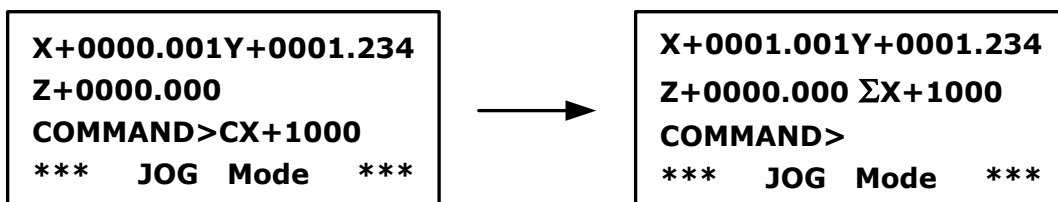
- The following describes how to calculate feed per minute from steps.
A step is equal to 450mm/min.
So that, the equation is *Feed per minute = the number of step × 450 mm/min.*
For example, default is $5 \text{ steps} \times 450 = 2250 \text{ mm/min.}$

Move by Manual Input Command

By using the manual input command, you can move the selected axis as the specified amount. It is useful to set the Z-axis height.

Usage:

- Press the *X* or *Y*, *Z* key of axis that you want to move. The LCD screen displays CX or CY, CZ.
- Press the + or – key of direction that you want to move to. The LCD screen displays CX+, CX- or CY+, CY-, CZ+, CZ-.
- Input the amount to move by using the digit keys. The LCD screen displays as shown below.
- Then press the **ENTER** key. The selected axis moves as the specified amount. The LCD screen displays as shown below.



Note:

- The selected axis moves by the speed set in the “Move Axis by Jog” section.
- When you want to modify the input, press the **BS** key. Then one character is deleted.
- When you want to cancel the input fully, press the **CLR** key.
- If you want to move the same amount repeatedly, press the **ENTER** key repeatedly.

Manual Mode (Step Jog Mode)

X+0000.001Y+0001.234
Z+0000.000
COMMAND>
**** Step JOG Mode ****

Select Manual Speed

Please use *Slow*, *Fast* buttons.

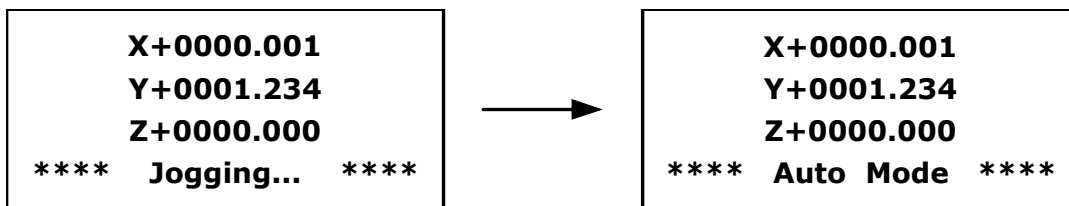
5.3.3. Auto Mode

All commands are controlled in the auto mode by the PCNC program. To convert to the auto mode, press the **MODE** key. The LCD screen displays as shown below. This display means that the selected mode is the auto mode.

X+0000.001
Y+0001.234
Z+0000.000
****** Auto Mode ******

Move by PCNC Program

When the selected axis moves with jog commands received from PCNC program, the LCD screen displays as shown below. When the movement finishes, the display returns to the previous status.



Pause/Restart

To pause automatic operation, press the **PAUSE** key. The LCD screen displays as shown below.

X+0000.001
Y+0001.234
Z+0000.000
******* PAUSE *******

To restart automatic operation, press the **PAUSE** key again. The display returns to the previous status.

Chapter 6.

Troubleshooting

6.1 Error Codes

6.2 Other Problems

6. Troubleshooting

6.1. Error Codes

If you have the operation panel or the remote terminal, error codes are displayed on the LCD. Also error codes and message as shown below are displayed on the PCNC program in PC.

Display (ERR=)	Contents	Check
PWR_OFF	No Input Signal	Check the connection of motor cables.
EMERGENCY	Emergency Stop	Check whether the emergency switch is locked or unlocked.
SERVO	Servo Alarm	Check the connection or the power of servo motor drivers.
LMT X+	Over Travel: X +	The X + side exceeded the stroke limit. Move X-axis to – direction.
LMT X-	Over Travel: X -	The X - side exceeded the stroke limit. Move X-axis to + direction.
LMT Y+	Over Travel: Y +	The Y + side exceeded the stroke limit. Move Y-axis to – direction.
LMT Y-	Over Travel: Y -	The Y - side exceeded the stroke limit. Move Y-axis to + direction.
LMT Z+	Over Travel: Z +	The Z + side exceeded the stroke limit. Move Z-axis to – direction.
LMT Z-	Over Travel: Z -	The Z - side exceeded the stroke limit. Move Z-axis to + direction.
LMT W+	Over Travel: W +	The W+ side exceeded the stroke limit. Move W-axis to – direction.
LMT W-	Over Travel: W -	The W- side exceeded the stroke limit. Move W-axis to + direction.

6.2. Other Problems

Contents	Check Item
The connection between PC and FCU1 isn't working.	Check the power of FCU1. Check the status of USB cable.
The servo alarm occurs continuously.	Check the connection between FCU1 and servo drivers. Check the power of FCU1. Check the connection of motors.
The limit error is displayed always.	Check the limit switch. Check that the limit switch is B contact. (If you don't use the limit switch, you must connect the I/O to +24V.)
Motors are not working.	Check the connection between FCU1 and servo drivers. Check the status of servo drivers. Check the limit of Z-, W+ and W- directions.

NC Programming

7.1 G Code

7.2 Positioning (G00)

7.3 Linear Interpolation (G01)

7.4 Circular Interpolation (G02,G03)

7.5 Dwell (G04)

7.6 Automatic acceleration/deceleration (G08,G09,G61,G64)

7.7 Plane Selection (G17,G18,G19)

7.8 Inch/Metric Conversion (G20/G21)

7.9 Automatic Return to Reference Point (G28)

7.10 Setting Coordinate System (G50)

7.11 Local Coordinate System (G52)

7.12 Setting Machine Coordinate System (G53)

7.13 Selecting Work Coordinate System (G54~G59)

7.14 Absolute/Incremental Command (G90/G91)

7.15 Drilling Cycle (G80/G81/G83)

7.16 M Code

7.17 M Code Program Example

7. NC Programming

7.1. G Code

A number following address G determines the meaning of the command for the concerned block.

G codes are divided into the following two types.

- One-shot G code – The G code is effective only in the block in which it is specified.
- Modal G code – The G code is effective until another G code of the same group is specified.

The following G codes are offered in **FAWOO** PCNC.

G Code	Function
G00 *	Positioning (Rapid traverse)
G01	Linear interpolation (Cutting feed)
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04 △	Dwell #
G08 △	Automatic acceleration
G09 △	Automatic deceleration
G17	XY plane selection
G18	ZX plane selection
G19	YZ plane selection
G20	Input in inch #
G21 *	Input in mm #
G28 △	Return to reference position #
G40 *	Cutter compensation cancel
G43	Tool length compensation + direction
G44	Tool length compensation – direction
G49 *	Tool length compensation
G50 △	Setting coordinate system #
G52 △	Local coordinate system selection
G53 △	Machine coordinate system selection #
G54~G59	Work-piece coordinate system 1~6 selection #

G61	Automatic acceleration/deceleration
G64	Automatic acceleration/deceleration cancel
G80 *	Drilling cycle cancel
G81	Drilling cycle
G83	Drilling cycle
G90 *	Absolute command mode
G91	Incremental command mode
G98 *	Return to initial point
G99	Return to R point

Note:

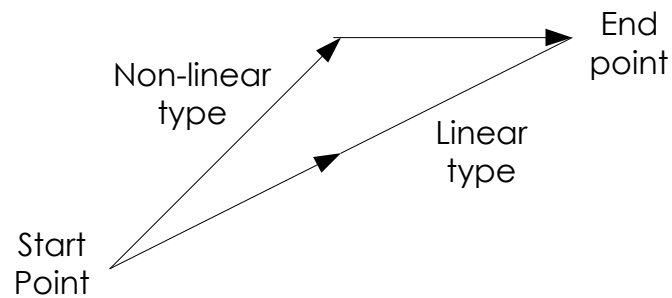
- G codes marked $\triangle$ are one-shot G codes.
- G codes marked * are initial G codes when turning power on.
- G codes marked # must be specified alone.
- G code can be specified maximum 5 in the same block.

7.2. Positioning (G00)

G00 specifies positioning. A tool moves to a certain position in the work coordinate system with an absolute command or to a position specified distance from the current position with an incremental command at a rapid traverse rate. Format is as shown below.

G00 P_ (P_ is combination of optional axis address (of X, Y, Z))

There are two types of positioning, linear and non-linear. There is only linear type in **FAWOO** PCNC system. But the linear type of positioning is used in the mode of G28 (Return to reference position).



7.3. Linear Interpolation (G01)

Format is as shown below.

G01 P_ F_

This command actuates the linear interpolation mode. The values of **P_** define the distance of tool traveling which will be conducted in absolute or incremental mode, according to the current status of G90/G91. The feed rate is set a cutting speed commanded by F code and is a modal data.

The feed rate commanded by the F code is measured along the tool path. If it is not commanded, the feed rate is regarded as zero.

The feed rate of each axis direction is as follows:

$$\begin{aligned}F_x &= F \times \frac{\Delta x}{L} \\F_y &= F \times \frac{\Delta y}{L} \\F_z &= F \times \frac{\Delta z}{L} \\L &= \sqrt{\Delta X^2 + \Delta Y^2 + \Delta Z^2}\end{aligned}$$

The limit of feed rate is determined by each axis feed rate. That is, the minimum among

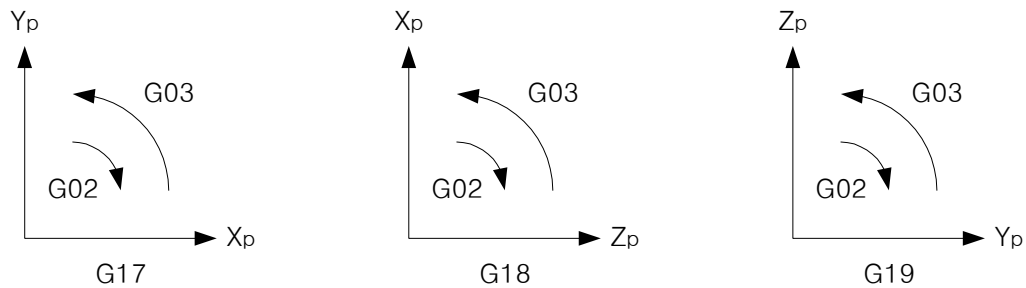
F_x, F_y, F_z is the limit of feed rate.

7.4. Circular Interpolation (G02, G03)

This command below will move a tool along a circular arc. Format is as shown below.

G02 : Circular Interpolation CW
G03 : Circular Interpolation CCW

The view is from the positive direction of the Zp axis (Yp axis or Xp axis) to the negative direction on XpYp plane (ZpXp or YpZp plane) in the right hand Cartesian coordinate system. When the power is turned on, the default plane is G17.



The command below will move a tool along a circular arc.

$$\text{Arc on } X_p Y_p \text{ plane: } G17 \begin{Bmatrix} G02 \\ G03 \end{Bmatrix} X_p \_ Y_p \_ \begin{Bmatrix} I\_ J\_ \\ R\_ \end{Bmatrix} F\_$$

$$\text{Arc on } Z_p X_p \text{ plane: } G18 \begin{Bmatrix} G02 \\ G03 \end{Bmatrix} X_p \_ Z_p \_ \begin{Bmatrix} I\_ K\_ \\ R\_ \end{Bmatrix} F\_$$

$$\text{Arc on } Y_p Z_p \text{ plane: } G19 \begin{Bmatrix} G02 \\ G03 \end{Bmatrix} Y_p \_ Z_p \_ \begin{Bmatrix} J\_ K\_ \\ R\_ \end{Bmatrix} F\_$$

Where,

X_p, Y_p, Z_p : End point position

I, J, K : Distance from start point to center

R : Arc radius

F : Feed rate

The arc center is specified by addresses I, J and K for the Xp, Yp, Zp axes, respectively. The numerical value following I, J or K, however, is a vector component in which the arc center is seen from the start point, and is always specified as an incremental value irrespective of G90 and G91.

The radius can be specified with address R instead of specifying the center by I, J or K. In this case, two types of arcs (one arc is less than 180° , and the other is more than 180°) are considered. When an arc exceeding 180° is commanded, the radius must be specified with a negative value.

Note:

- I0, J0, and K0 can be omitted.
- If Xp, Yp and Zp are all omitted or if the end point is located at the same position as the start point, and when the center is commanded by I, J, and K an arc of 360° (a complete circle) is assumed.
 - G02 I_ (A complete circle)
 - When R is used, an arc of 0° is programmed
 - G02 R_ (The cutter does not move)
- When the difference between the radius of the start point and that of the end point is over 0.01mm or 0.001 inch, the error occurs.
- Plane selection (G17, G18 and G19) is commanded with G02, G03 in the same block. But if it is not necessary to change the plane, the plane selection codes can be omitted.
- When an arc is less than 180° , the performed interpolation is not the circular interpolation but the linear interpolation if the distance between the start point and the end point is less than $10\mu\text{m}$ or 0.001inch..

7.5. Dwell (G04)

With the G04 command, shifting to the next block can be delayed. Shifting to the next block can be delayed for the commanded minutes. Format is as shown below.

G04 X_ or G04 P_

Dwell time is commanded in seconds 0.001~9999.999 sec. But decimal points cannot be used with address P. For example, if you want to delay 1sec, you must command X1.0 or P1000.

Note: The G04 command is one-shot G code. This G code is effective only in the block where it is specified.

7.6. Automatic acceleration/deceleration (G08, G09, G61, G64)

Acceleration and deceleration is performed when starting and ending movement, resulting in smooth start and stop. You can select which acceleration and deceleration is performed or is not performed in cutting block by G codes. Format is as shown below.

G08	Automatic acceleration
G09	Automatic deceleration
G61	Automatic acceleration/deceleration
G64	Automatic acceleration/deceleration cancel

G61, G64 are modal G codes.

G08, G09 are one-shot G codes.

When G61 is commanded, acceleration and deceleration is applied to the start point and end point of cutting block thereafter. This G61 is valid till G64 is commanded.

When G64 is commanded, acceleration and deceleration at the start point and end point is not performed thereafter, and cutting goes on the next block. This command is valid till G61 is commanded.

When G08 is commanded in the G64 mode, acceleration is applied to the start point of cutting block in which it is specified.

When G09 is commanded in the G64 mode, deceleration is applied to the end point of cutting block in which it is specified.

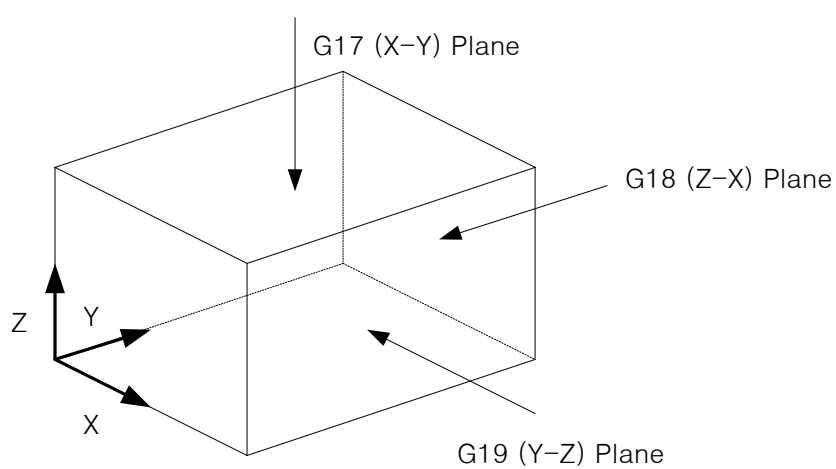
Note:

- Automatic acceleration/deceleration is also performed when feed rate changes, so change in speed is also smoothly done.
- G64 is initial G code.

7.7. Plane selection (G17, G18 and G19)

Select the planes for circular interpolation. When the power is turned on, the G code is G17.
Format is as shown below.

G17 : XY plane selection
G18 : ZX plane selection
G19 : YZ plane selection



7.8. Inch/Metric Conversion (G20/G21)

Either inch or metric input can be selected by G code. Format is as shown below.

G20 : Inch command, Least input increment 0.00001inch
G21 : Metric command, Least input increment 0.0001mm

This G code must be specified in an independent block before setting the coordinate system at the beginning of the program. The unit systems of the following items can be changed with G code.

- Positional command
- Feed rate commanded by F code
- Tool length compensation offset

Note:

- G20 and G21 are modal G code.
- When the power is turned on, the initial G code is G21.
- G20 and G21 must not be switched during a program.

7.9. Automatic Return to Reference Position (G28)

This command specifies automatic return to the reference position for the specified axes. Format is as shown below.

G28 P_

P_ is an intermediate coordinate and is commanded by absolute or incremental value. Positioning to the intermediate or reference points is performed at the rapid traverse rate of each axis. Positioning to the intermediate or reference points is performed at the non-linear type rapid traverse.

7.10. Setting Coordinate System (G50)

Format is as shown below.

G50 P_ (if P is X, Y, Z, set coordinate, if P is U, V, W, shift coordinate)

This command establishes the work-piece coordinate system so that a certain point of the tool becomes **P_** in the established work-piece coordinate system. The coordinate of axes that are not specified isn't changed. Any subsequent absolute commands use the position in this work-piece coordinate system. The incremental command (U, V, W) establishes the work-piece coordinate system by adding the incremental values to the current coordinate system. It is called the shifting coordinate.

Notes:

- G50 command is one-shot G code.
- Axes are not moved by G50 command.
- The work-piece coordinate system established by G50 command can be canceled by G50, G53, G54~G59 codes and the termination of PCNC program. When the power is turned on, the work-piece coordinate system is same as the machine coordinate system.
- When G50 is commanded, the drilling cycle must be canceled.
- If a coordinate system is set with the G50 command in tool length compensation mode, the coordinate system is set so that the position before tool length compensation is applied becomes that specified by G50.

Example:

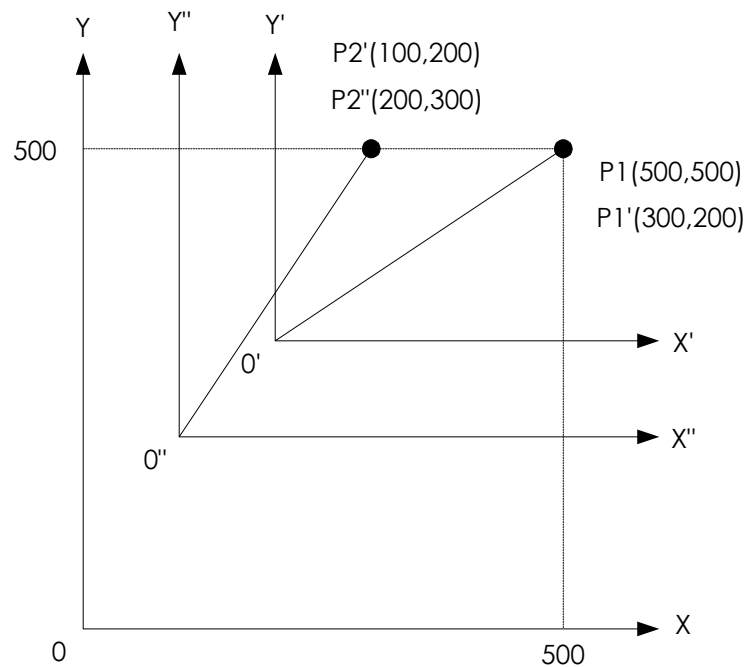
N10 G00 X500. Y500.

N20 G50 X300. Y200.

N30 G00 X100.

N40 G50 U100. V100.

The G50 coordinate system is equal to the machine coordinate system in N10, so the program coordinate is P1 (500, 500). When N20 is executed, the G50 coordinate system is changed to X'-Y'. The program coordinate is changed to P1' (300, 200) in N20 and moves to P2' (100, 200) in N30. When N40 is executed, the G50 coordinate system is changed to X''-Y''. The program coordinate is changed to P2'' (200, 300).



7.11. Local Coordinate System (G52)

While programming in a work-piece coordinate system, it is sometimes more convenient to have a child coordinate system within the work-piece coordinate system. Such a child coordinate system is called a local coordinate system. Format is as shown below.

G52 P_

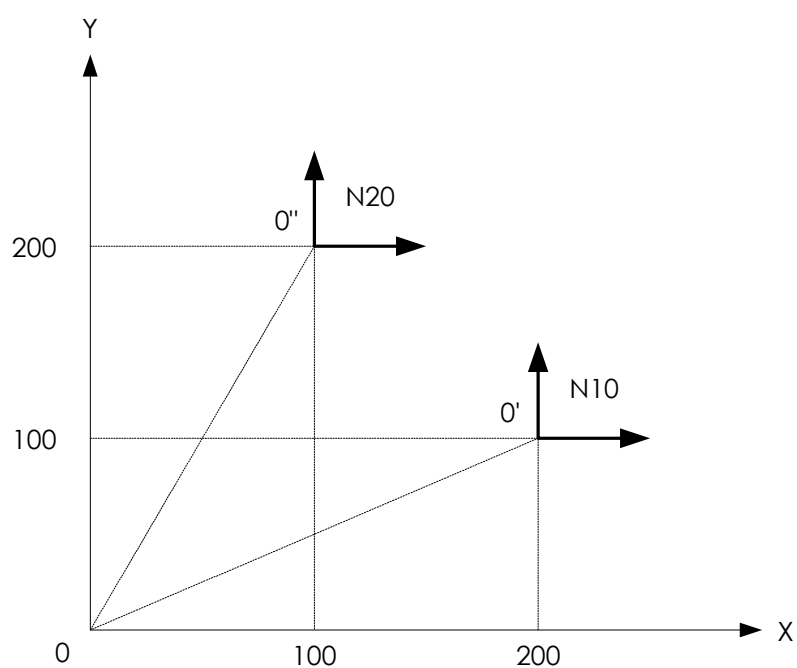
This command specifies local coordinate systems, for all work-piece coordinate system. When a local coordinate system is set, the move commands in the absolute mode (G90), which is subsequently commanded as are the coordinate values in the local coordinate system. The local coordinate system can be changed by specifying the G52 command with the zero point of a new local coordinate system in the work-piece coordinate system. To cancel the local coordinate system and specify the coordinate value in the work-piece coordinate system, match the zero point of the local coordinate system with that of the work-piece coordinate system. That is, 'G52 P0', should be specified. The G52 code must be commanded in the absolute mode (G90), not the incremental mode (G91).

Note: The local coordinate system established by G52 command can be canceled by G50, G53, G54~G59 codes and the termination of PCNC program.

Example:

N10 G52 X200. Y100.
N20 G52 X100. Y200.
N30 G52 X0. Y0.

The local coordinate system O' is established in N10. Also the local coordinate system O'' is established in N20. The local coordinate system is canceled in N30.



7.12. Setting Machine Coordinate System (G53)

When this command is specified, the tool moves to the position of the P_ coordinate value in the machine coordinate system at rapid traverse. Format is as shown below.

G53 P_

When the tool moves to a position specially determined for the machine tool, such as tool change position, programming is performed in the machine coordinate system by using the G53 command.

Note:

- Since G53 is a one-shot G code, it is effective only in the block where G53 is specified.
- Positioning of the G53 is performed at the linear type rapid traverse.
- By G53 command, the work-piece coordinate system is canceled. And the coordinate system is same as machine coordinate system.
- When G50 is commanded, the drilling cycle must be canceled.

7.13. Selecting Work-piece Coordinate System (G54~G59)

Six coordinate systems proper to the machine tool are set in advance, permitting the selection of any of them by G54 to G59. Format is as shown below.

G54	: Selecting work-piece coordinate system 1
G55	: Selecting work-piece coordinate system 2
G56	: Selecting work-piece coordinate system 3
G57	: Selecting work-piece coordinate system 4
G58	: Selecting work-piece coordinate system 5
G59	: Selecting work-piece coordinate system 6

The six coordinate systems are determined by setting distances (work-piece zero offset values) in each axis from the machine zero point to their respective zero points using the G5X Work Coordinates dialog box.

Note:

- The local coordinate system established by G52 command can be canceled by G54~G59.
- The work-piece coordinate system established by G54~G59, G50 command doesn't be canceled until the PCNC program is terminated.
- By G53 command, the work-piece coordinate system is canceled. And the coordinate system is same as the machine coordinate system.
- When the PCNC program is started initially, the work-piece coordinate system is same as the machine coordinate system.
- When G54~G59 is commanded, the drilling cycle must be canceled.

Example: Assume that offset of work-piece coordinate system 1 (G54) is X=100. Y=100 and the offset of work-piece coordinate system 2 (G55) is X=150. Y=300.

N10 G54

: Selecting of work-piece coordinate system 1

N20 X50. Y0.

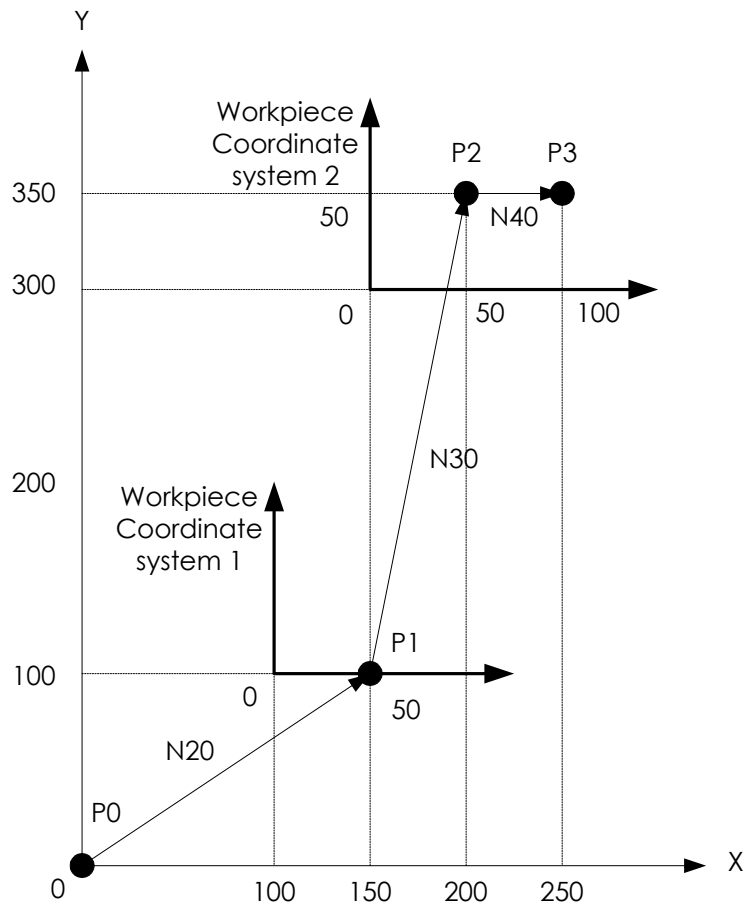
: Move from P0 to P1

N30 G55 X50. Y50.

: Selecting of work-piece coordinate system 2 and move from P1 to P2

N40 X100.

: Move from P2 to P3



7.14. Absolute/Incremental Command (G90/G91)

There are two ways to command travel of the axes, the absolute command and the incremental command. In the absolute command, coordinate value of the end point is programmed. In the incremental command, move distance of the axis itself is programmed. G90 and G91 are used to command absolute or incremental command, respectively. Format is as shown below.

G90 : Absolute command
G91 : Incremental command

You can use U, V, W as the incremental command of X, Y, Z in both G90 mode and G91 mode.

Example:

G00 X_ Y_	→ X and Y are absolute commands.
U_ V_	→ X and Y are incremental commands.
X_ V_	→ X is the absolute command and Y is the incremental command.
G91	→ The incremental mode is selected.
X_ Y_	→ X and Y are incremental commands.
U_ Y_	→ X and Y are incremental commands.
G90	→ The absolute mode is selected.
X_ V_	→ X is the incremental command and Y is the absolute command.

Note:

- G90 and G91 are modal G codes.
- When the PCNC program is started initially, the initial G code is G90.

7.15. Drilling Cycle (G80/G81/G83)

A drilling cycle simplifies the program by using a single block with a G code to specify the machining operation specified in several blocks. Format is as shown below.

G81 (G83) X_ Y_ Z_ R_ Q_ P_ F_ K_

Item	Address	Content
Hole position data	X (U) Y (V)	Specifies the position of hole by an incremental or absolute value.
Drilling data	Z (W)	Specifies the distance from point R to the bottom of the hole with an incremental value or the position of the bottom of the hole with an absolute value. It is the rapid traverse rate or the feed rate specified in the F code, according to the drilling mode.
	R	Specifies the distance from the initial level to point R level. The feed rate is rapid traverse rate.
	Q	Specifies each cut-in value with peck drilling and step drilling. (0.001mm or 0.0001inch) Always specified with an incremental value.
	P	Specifies the dwell time at the bottom of the hole. The relationship between the time and the specified value is the same as for G04.
	F	Specifies the feed rate
Number of repeats	K	Specifies the number of repeats for a series of operation 1 to 6. When K is not specified, K=1 is assumed.

Since the drilling mode (GXX) remains unchanged until another drilling mode is specified or the drilling cycle is canceled with a G code, it need not be specified any blocks when the same drilling mode continues. G80, G00, G01, G02 and G03 codes are used to cancel a drilling cycle. The number of repeats K shall be specified only when operation must be repeated. The feed rate specified with F code is retained even if the drilling cycle is canceled.

7.15.1. Basic operation of Drilling Cycle

A drilling cycle consists of a sequence of six operations.

Operation 1: Positioning of axes X and Y (including also another axis)

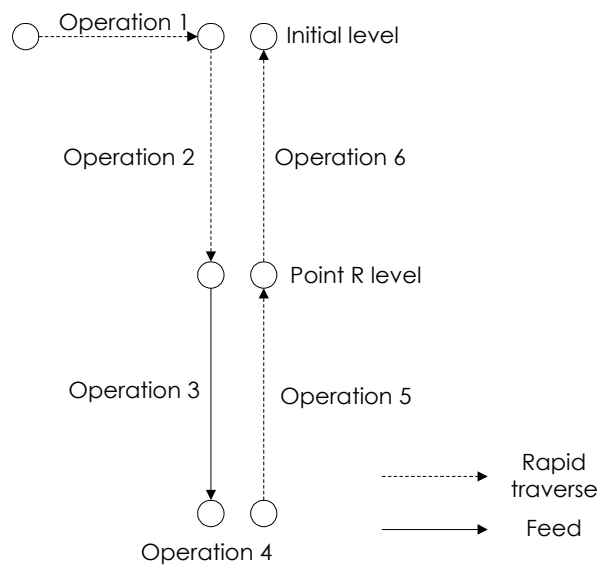
Operation 2: Rapid traverse up to point R level

Operation 3: Hole machining

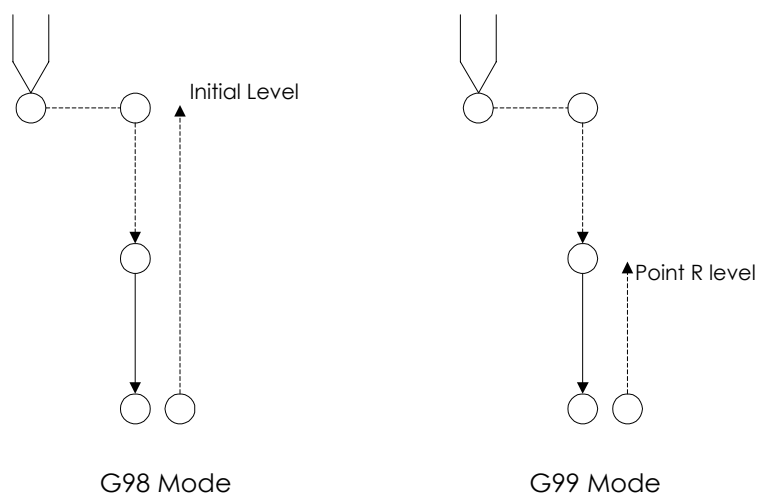
Operation 4: Operation at the bottom of a hole

Operation 5: Retraction to point R level

Operation 6: Rapid traverse up to the initial point



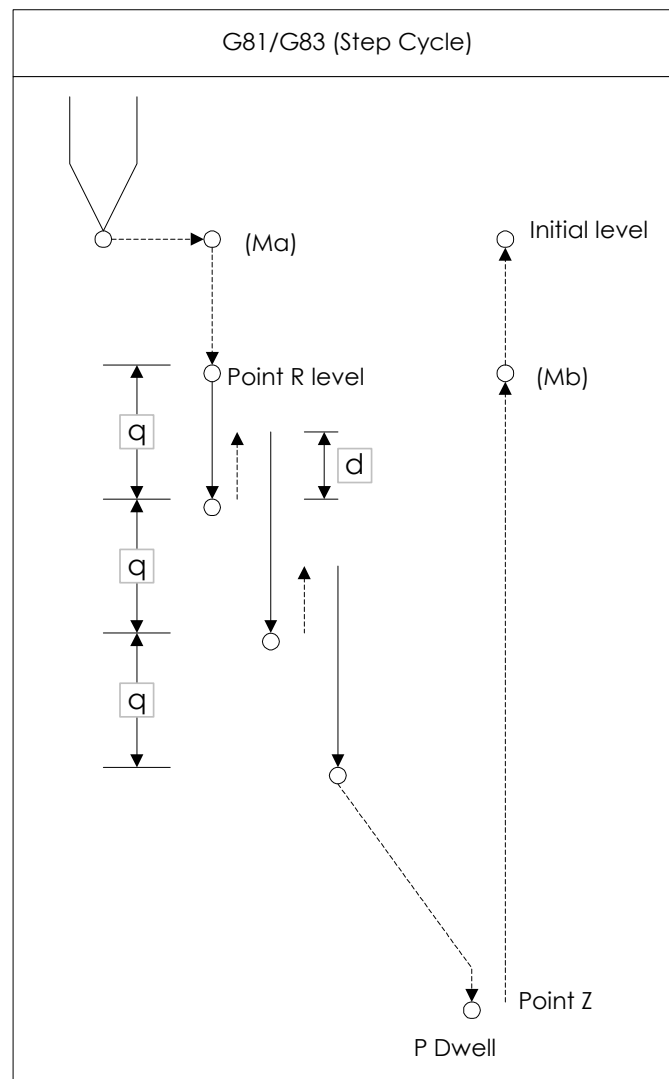
Whether the tool is to be returned to point R level or to the initial level is specified according to G98 or G99.



7.15.2. Operation of G81/G83 Drilling Cycle

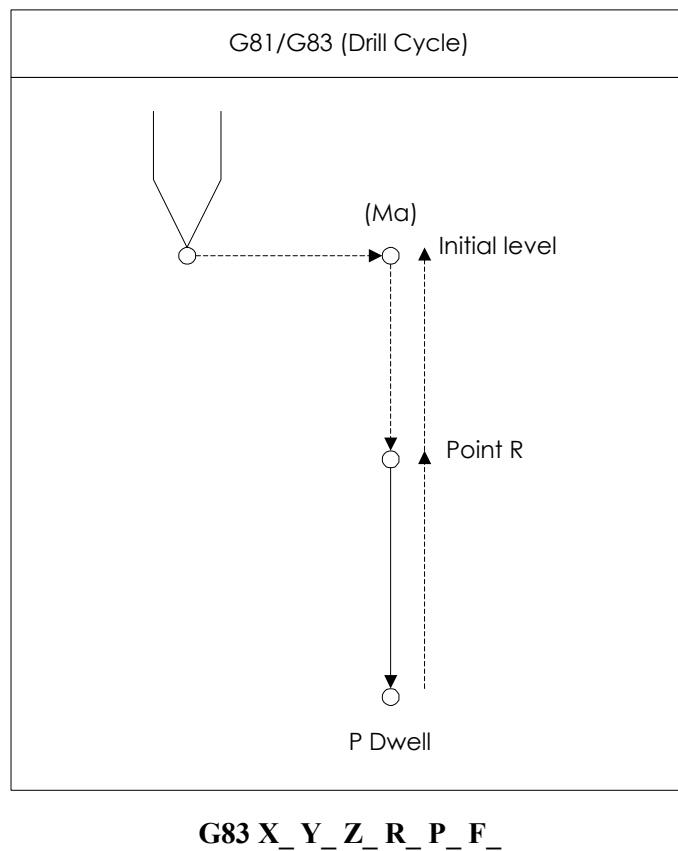
Assume in the G98 (Return to initial point) mode. Dashed line is represented rapid traverse and solid line is represented cutting feed. With a Q command, it is operated as peck drilling or step drilling. Without Q command, it is operated as drilling cycle. Whether the drilling is operate as peck drilling or step drilling is according to the configurations of drilling cycle.

Type A with Q command



G83 X_Y_Z_R_Q_P_F_

The retraction d is set by a parameter. Since the Z-axis direction intermittent feed simplifies chip disposal and permits a very small retraction value to be set in deep drilling hole, efficient machining is performed. Retraction is performed at the rapid traverse rate. P_ command is specifies the dwell time at the bottom of the hole.

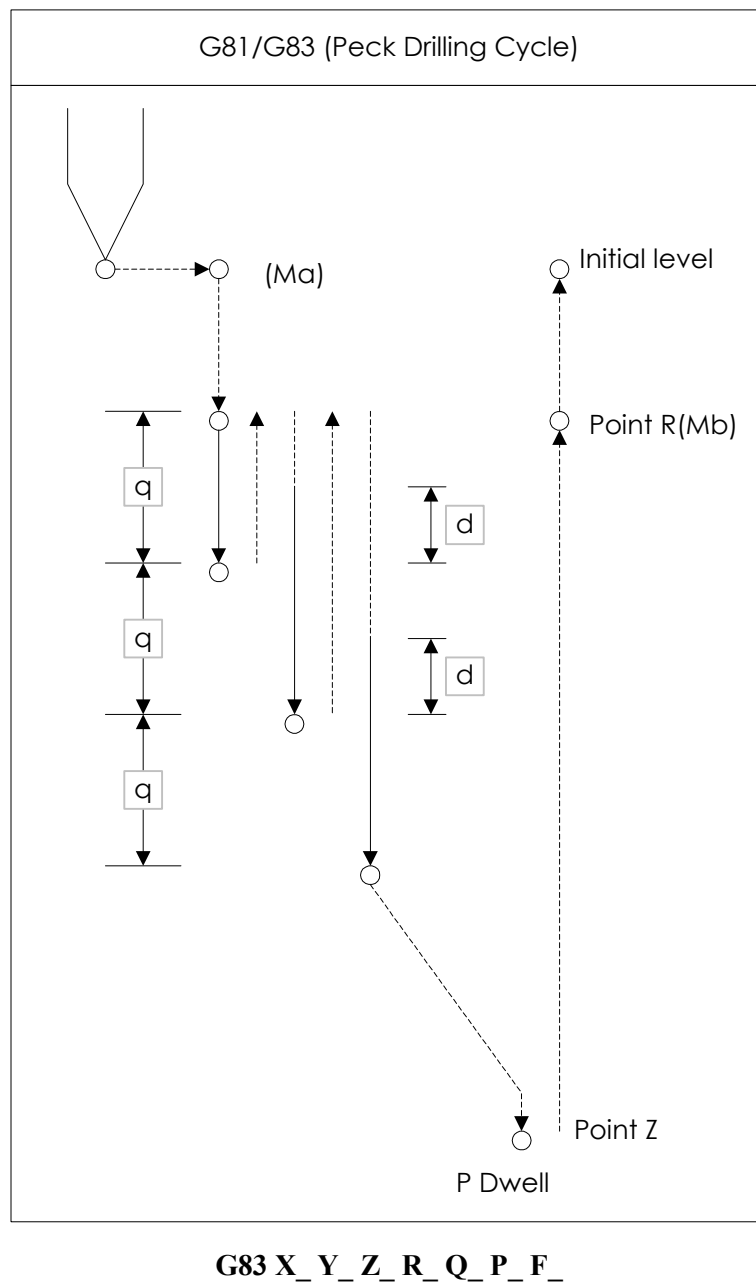
Without Q command

With a Q command, it is operated as peck drilling or step drilling. Without Q command, it is operated as drilling cycle. Whether the drilling is operated as peck drilling or step drilling is according to the configurations of drilling cycle.

Example:

G81/G83 X_ Y_ Z_ R_ Q_ F_	→ Step drilling or Peck drilling
X_ Y_	→ Step drilling or Peck drilling
X_ Y_ Z_ Q_	→ Step drilling or Peck drilling
G81/G83 X_ Y_ Z_ R_ P_ F_	→ Drilling
X_ Y_ R_	→ Drilling
X_ Y_ Z_ Q_	→ Drilling, Q is ignored

Type B with Q command



The retraction d is set according to the configurations of drilling cycle. The configurations of drilling cycle are set in the Configuration dialog box.

7.15.3. Drilling Cycle Cancel (G80)

The drilling cycle is cancelled and normal operation is subsequently performed. Format is as shown below.

Example:

G83 X_ Y_ Z_ R_ F_	→ Start drilling cycle
G80	→ Cancel drilling cycle

7.15.4. Repeat of drilling cycle

If holes are repeatedly drilled at equal intervals in the same drilling cycle, specify the number of repeats using address K. The maximum value of K is 9999. K is effective only for the specified block.

7.15.5. Notes

If the block contains X, Y, Z, R or additional axes data, drilling is performed in drilling cycle mode. If the block does not contain the X, Y, Z, R and additional axes data, drilling is not performed. However, when G04 X_ is specified, drilling is not performed even if X is specified. Format is as shown below.

G00 X_ Y_	
G83 X_ Y_ Z_ R_ F_	
F_	(Drilling is not performed. Value F is updated.)
M_	(Drilling is not performed. Only the miscellaneous function is executed)
G04 P_	(Drilling is not performed. Drilling data is not changed by G04P)

As previously mentioned, a drilling cycle may also be cancelled with G00 to G03. This cancel is performed when G00 to G03 is read if it is specified in the same block as the G code of a drilling cycle.

Example:

G00 G83 X_ Y_ Z_ R_ F_	→ The drilling cycle is performed.
G83 G00 X_ Y_ Z_ R_ F_	→ Movement along the X, Y, and Z-axes is performed as specified in X_, Y_, Z_. R is ignored and F is stored

7.16. M Code

The following M codes are offered in **FAWOO** PCNC. M10~29, M40~59 are user define M code for I/O control

M Code	Function
M00/M01	Program Pause
M02/M30	Program End
M03, M04/M05	Spindle (Output0) On/Off
M08/M09	Coolant (Output1) On/Off
M10/M20	Output port 0 is On/Off
M11/M21	Output port 1 is On/Off
M12/M22	Output port 2 is On/Off
M13/M23	Output port 3 is On/Off
M14/M24	Output port 4 is On/Off
M15/M25	Output port 5 is On/Off
M16/M26	Output port 6 is On/Off
M17/M27	Output port 7 is On/Off
M18/M28	Output port 8 is On/Off
M19/M29	Output port 9 is On/Off
M40/M50	Wait until Input port 0 is High/Low
M41/M51	Wait until Input port 1 is High/Low
M42/M52	Wait until Input port 2 is High/Low
M43/M53	Wait until Input port 3 is High/Low
M44/M54	Wait until Input port 4 is High/Low
M45/M55	Wait until Input port 5 is High/Low
M46/M56	Wait until Input port 6 is High/Low
M47/M57	Wait until Input port 7 is High/Low
M48/M58	Wait until Input port 8 is High/Low
M49/M59	Wait until Input port 9 is High/Low

- M codes for controlling inputs wait until the signal state become high or low. When the signal is correct, proceeds the step.

7.17. M code programming example

N10 G90 : Absolute coordinate command

N20 G00X10.Y10. : Positioning to (10,10) coordinate

N30 M10 : Output port 0 is On

N40 M20 : Output port 0 is Off

N50 M11 : Output port 1 is On

N60 M21 : Output port 1 is Off

N70 M12 : Output port 2 is On

N80 G00 X0.Y0. : Positioning to (0,0) coordinate

N90 M40 : Wait until input port 0 is high. When input port 0 is high, go on N100 step.

N100 M50 : Wait until input port 0 is low. When input port 0 is low, go on N110 step.

N110 M41 : Wait until input port 1 is high. When input port 1 is high, go on N120 step.

N120 M30 : End of program

MEMO

Chapter 8.

Dealing with DXF Files

8.1 Creating DXF Files

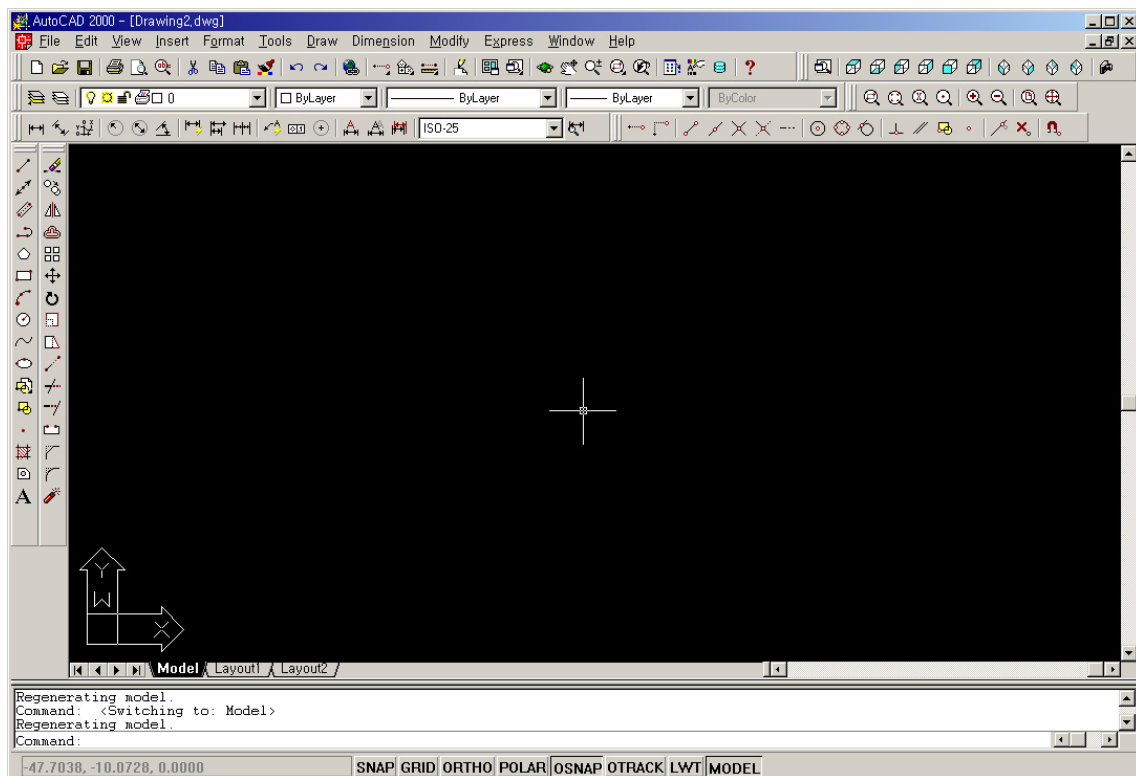
8.2 Drawing up DXF Files

8. Dealing with DXF Files

This chapter describes how to deal with DXF Files. You can process DXF files with PCNC software. Also you can use DXF files more easily with the Layer Setting dialog box. (see the “Program User Manual” chapter)

8.1. Creating DXF Files

DXF files are generally drawn up by AutoCAD program. When you save the plan drawn up in AutoCAD program, you must save as DXF file format for creating DXF file. Of course, DXF files created by other CAD/CAM programs are compatible. The following picture is the main window of AutoCAD program.



Note: Commands or formats in DXF files are different according to AutoCAD program version. The processing DXF files of PCNC software is optimized to AutoCAD R12 version. So you must save as DXF file format of AutoCAD R12 version when you make DXF files with AutoCAD or CAD/CAM programs.

8.2. Drawing up DXF Files

The following sentences explain how to draw up DXF files.

- The commands processed by PCNC software are ***Point***, ***Line***, ***Spline***, ***Polyline***, ***Rectangle***, ***Arc***, ***Circle***, ***Ellipse***, ***3D Polyline***, ***Polygon***, etc. When you draw up DXF files, you must use the feasible commands. But you can use the edit commands.
- To draw up text, you must use ***Txtexp*** command.
- ***Block*** isn't processed. So you must delete ***Block*** after using it.
- The unnecessary elements must be deleted by ***Purge***.
- The radius of ***Arc***, ***Circle*** or ***Polyline*** must be not over 65536.
- The name of layer must be only 0~9. If the name of layer isn't 0~9, the name of layer is considered as 0.
- The element drawn up earlier is processed earlier.
- You must use X-Y coordinate.